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OF WHAT VALUE ARE ELECTRICAL METHODS IN THERAPEUTICS?

A distinguished physician recently criticised very sharply the use of electrical methods in treating disease. He said that, in his opinion, the greater number of those who practise such methods are simply playing upon the imaginations of their patients. He admitted that there are a goodly number of physicians who employ these methods, believing in them fully, but he himself questions whether they have any great value, and whether the good which they accomplish in some cases offsets the evil done in others. He doubts greatly whether there is any value in any of the methods commonly used.

This question is one which doctors will have to decide for themselves, though suffering humanity will assist materially by submitting to the experimentation. That good is accomplished in some instances can hardly be denied. Many persons who merely imagine themselves unwell, as well as others who are really out of sorts, are benefited by believing that something is being done for them, and in these cases the question of whether the effect of the electric current is physical or merely mental is of little consequence. On the other hand, it can not be questioned that there are numbers who suffer in their pocket without obtaining any physical benefits from such treatments. This probably can not be helped entirely, for physicians are not always infallible, and some sick people are gullible. Now that the subject has been brought to the public attention so vigorously, would it not be well for the doctors to get together and see if they can not, in some way or other, determine what virtue there is in such treatments? This is a matter somewhat out of the province of a technical paper, but we are interested in the matter both as men and as electricians, and it goes against the grain to be told that any application of electricity which we believe to be beneficial—in part, at least—is totally worthless. Moreover, we would like to know whether, in the long run, the physicians have been wasting their time and our money, or not.

ELECTRICAL POWER FOR FARM WORK.

From time to time the advantages of electric power for performing certain kinds of farm work have been pointed out. It is cheap, clean, and always ready for work. In certain restricted districts in Europe the electric motor has been put to use on the farms, with great success, but, taking it on the whole, this is one of the lesser applications of electricity. In this country it has been used also for such work, but only in few instances. Many reasons might be assigned for this, probably most of them more or less true. The first expense of the equipment is a stumbling block oftentimes; electric power is not everywhere available at low rates, and the average farmer is a conservative workman. He sows and reaps much as his fathers did before him.

A recent announcement in the daily papers seems to indicate that an entering wedge has been started in the electrification of the farm. The Fort Wayne & Wabash Valley Traction Company, Fort Wayne, Ind., is offering to sell power to farmers within certain distances of its line for operating farm machinery. This experiment will be watched closely by other power companies, for if the Fort Wayne & Wabash Valley Traction Company makes a success and demonstrates to the farmers the advantages of the electric motor, an enormous field for the sale of electric power and apparatus will be opened.

Precaution should be exercised, however, in this extension of electric power service, for not all farms, nor all farmers, are adapted to the electric drive. If motors and power are sold indiscriminately there is a possibility—even a probability—of a disappointing outcome. Wherever power is required for a certain average number of hours per day, the electric motor is undoubtedly cheaper than the horse, but no fixed limit can be set. The costs of power and of labor vary, and what is true of one section may not be true of another. It is gratifying to be informed that this extension of electric power service is to be tried. It is to be hoped that it will be tried intelligently. If so, there need be no fear of the outcome.

POWER-STATION PROBLEMS AND DEVELOPMENT.

On another page of this issue will be found the excellent paper read by Mr. Fred N. Bushnell before the meeting of the American Railway Mechanical and Electrical Association, at Philadelphia, on "The Power Station," which takes up, in a clear manner, the many considerations to be borne in mind in designing a power plant. It is a rather interesting fact that in discussing or describing a power-house, we almost always take up the matter in an order which is the reverse of that which must be followed in the first instance by the designer. He must first determine what are the electrical needs to be supplied by the power-house. This known, he selects his electrical apparatus and chooses steam engines to suit. He then decides upon the boiler equipment required. Having thus practically determined upon the main equipment, he studies the ground available for the station, so as to secure the best arrangement. This is just the opposite of the general procedure in describing a plant. Then the location is described, its advantages and disadvantages being pointed out. Next comes a description of the boiler equipment, coal-handling apparatus, etc.; then the engine room, and finally the switchboard and the transmission plant. It is true that, having decided upon the main points in the design, the details may be worked out from the viewpoint of the central station. The transmission line is calculated to give not more than a certain loss in potential to the points of distribution, but this is merely adapting the situation chosen to the system which it serves.

The electric power station of to-day, after passing through many stages of development, has become more or less standardized. The engineer endeavors, above all, to secure reliability, economy and simplicity, and certain well-recognized layouts of machinery have been found to meet these requirements most satisfactorily. With the introduction of the steam turbine, a new arrangement of the power-house machinery was not only possible, but seemed desirable, and one plan which has been adopted in a number of notable plants and has been looked upon as a standard design.

We must not believe, however, that we have as yet exhausted all the possibilities of the steam turbine as regards the power-station design. Local conditions are frequently paramount, and make advisable an entirely new arrangement of apparatus. Much depends upon the character of auxiliary equipment found most suitable, and this, in turn, is largely influenced by the cost of fuel. In a plant where fuel is high, and the greatest fuel economy must be obtained, elaborate auxiliary machinery may be required. On the other hand, where fuel is cheap, it may be more economical to adopt less refined and less expensive apparatus, and to use as little of it as possible. The only safe rule to follow is one which adopts as a first tentative plan the simplest and cheapest boiler, engine and generator equipment which will do the work reliably, and then modifies this equipment step by step, being sure that each step makes for greater reliability or greater economy. If each piece of additional apparatus can be shown to be a profitable investment, then the engineer is warranted in adopting it, but not otherwise.

One phase of power-house operation touched upon by Mr. Bushnell is that respecting the practice in the operation of auxiliaries. The auxiliaries are generally operated at constant load, and where the load varies, they must be prepared to care for the maximum. Since the average load is always less—and generally considerably less—than the maximum, the auxiliaries necessarily operate inefficiently. In a railway power station, where the load varies greatly, this condition is exaggerated, yet it is not to-day thought practical to attempt to govern the auxiliaries automatically. There is no reason why this should not be done, except that it might add to the complications of the station, and the benefits obtained might not compensate for this. If it seemed desirable, it would not be difficult to control the auxiliaries automatically, either from the engine governor, or, better still, by the generator controlling device. This development will possibly come in the future. At the present time there are more important details before us which must first be solved.

The introduction of the steam turbine has brought greater changes in power-house design than any factor since the coming of the direct-connected unit. The enthusiasm with which this new prime mover has been accepted has been remarkable. Four years ago a steam turbine of moderate size was a curiosity; to-day two of the largest makers of this machine have already accepted orders which aggregate over 800,000 horse-power. With a growth as rapid as this, it can not be expected that a development as perfect, as regards its type, as that of the reciprocating engine has taken place. There are still a good many problems to be solved. Losses occur in the turbine which are little understood, but which must be accounted for. The turbine enables us to operate with a greater degree of superheat and a higher vacuum—that is to say, between wider temperature limits than can be employed in the reciprocating engine. The turbine designs which have been adopted would seem to reduce the friction of the machine to a minimum, yet such records of performance as have been made public do not put the best reciprocating engine to shame. The latter machine seems, however, nearly to have reached its limit, and there is no prospect of any radical change. The steam turbine, on the other hand, while old in theory, is new in practice, and we may properly look for great improvements. It has one point in its favor which is appreciated by the electrical engineer; its uniform turning effort and its higher speed adapt it admirably to driving electrical machinery. Then again, it has made possible an important saving in space requirements of the power-house. Economy in fuel consumption is important, but it is not everything.

Another phase of power-station development, and one which has been frequently touched upon before, is the growth of the switchboard and the introduction of switches controlled from a distance. This principle has been extended so as to give the switchboard attendant some control over the prime mover, and

it is probable that it will be extended further. It might be extended to control all important steam valves. Fortunately, breaks in steam pipes are rare, but should one occur, the ability to shut off that section of the pipe from a distance might not only prevent a shutdown of the station, but save many lives.

One little point made in Mr. Bushnell's paper brings to mind an old controversy. In comparing two stations, he says: "It is probable that, had a storage battery been added to the equipment of station B, the load on the engines could have been regulated so as to have made a better showing in coal consumption, but it is still problematical if there is any net gain from the use of storage batteries in railway work." No question is raised as to the ability of the battery to smooth out the load on the station, but the old problem of whether a battery saves enough coal in this way to pay for the interest, depreciation and maintenance is still unsettled—at least, in Mr. Bushnell's mind.

ELECTRICITY IN THE HOUSEHOLD.

Much as electricity has done in adding to the comforts of the home, it promises yet much more—that is, if we accept the predictions of certain eminent authorities who have, for years past, studied, worked with and advanced, as much as they could, the applications of electricity. Colonel R. E. B. Crompton, past-president of the Institution of Electrical Engineers, of Great Britain, has followed every new use of the new power into every field. He is familiar with the great work that has been done, and he sees great opportunities now offering. Upon some of these he dwelt recently at a lecture given during an electrical exhibition held in London. For industrial uses, he says, the electric motor easily distances all rival means of supplying power. It is more economical, more convenient, and is brought under perfect control. He hopes for a greatly increased use of electric power in London, not only on the street but in the house, where great advantages would accrue and comfort would be much promoted. By its aid spring-cleaning may be banished, and houses kept ten times cleaner than they are under the present cyclical system of displacing dirt and dust. He prognosticated that before long, electric power will supersede the manual labor of the housemaid, for there is no reason why motors should not be used to drive machinery for washing dishes, cleaning plates, roasting and grinding coffee, chopping meat, kneading dough, doing the laundry work, as well as being utilized for artistic and decorative effects. They could clean the metal work, polish the silver and the jewelry, cool the refrigerator, rock the baby, press the clothes—in fact, the number of things that might be done in this way seems unlimited.

With the coming of the fall and the return of the family to the winter residence, the servant problem has again come to the fore, and is now, in exaggerated form, the most troublesome worry of the home. Let us hope that in these suggestions of Colonel Crompton we may find the final solution of this all-important question, and that, ere long, the modern household will be so well equipped with labor-performing devices that we will be able to look back on these bad days with horror, and with a feeling of gratitude that that ever-ready and uncomplaining slave—electricity—has at last taken the home under its charge.

LAMP RATINGS.

What everybody would like to have is a single rating which will denote fairly the value of any illuminant. Such a rating seems, however, to be unattainable, for there are at least three factors to be considered. There is the efficiency of the lamp as a light producer; next, the character of the distribution given by the lamp; third, the quality of the light itself. To base the value of a lamp on its showing in any one of these three ways alone is not satisfactory, for such a rating does not tell enough about the lamp. Among lamps of the same kind giving the same distribution of light, that having the highest efficiency is, of course, the best; but when the distribution is not the same, that lamp not requiring auxiliary apparatus has an advantage over an equally efficient lamp requiring a reflector. Possibly a scheme of classifying lamps according to the quality of the light, the character of the distribution given, and their efficiency as light producers, might be devised, which would give a satisfactory idea of the relative merits of different lamps; but, until some such means is adopted, lamp ratings must remain unsatisfactory. One characteristic of a lamp is not sufficient to judge of its merits, and, besides, there is still another factor which must always be considered—that is, the price of the lamp itself.

RECHARGING PRIMARY BATTERIES.

Not infrequently one finds in the technical press instructions for recharging primary batteries, particularly the type known as the dry battery. An instance was noted recently in which very specific details were given, the necessary apparatus listed and the method of conducting the charging described. Now, there is no denying the fact that dry batteries can be "recharged"—that is to say, partially restored to their active condition. But who wants to recharge a dry battery? In the case just mentioned, to perform this interesting experiment there were required four stone jars large enough to hold the dry cells, a small amount of sal ammoniac, and four cells of gravity battery, with a solution for charging the same. Aside from the question of whether four gravity cells would be capable of recharging four dry cells connected in series, and whether six or eight would not be necessary to do the work properly, would not the jars and the gravity cells cost more than the dry cells themselves? Dry cells are about the least expensive type of primary battery on the market. The gravity cell is not a cheap source of electrical energy, and when used as here proposed, it would require refilling at each recharge, since it can not be left standing, so that the cost of operating it would be greatly increased. Taken in connection with the trouble and the unreliable results obtained—since the recharged cells can never be as good as the new cells—it seems a waste of time and money. To charge them from a lighting circuit would seem to be a better plan, but even this is of doubtful efficacy. It would seem to be much better practice to throw old cells away and buy new. It seldom pays to make use of makeshifts when the proper apparatus itself costs but little.

THE ELECTRICAL NATURE OF MATTER AND RADIOACTIVITY.

BY HARRY C. JONES.

CHAPTER VI.—*Concluded.*

THE SPECTRUM OF RADIUM.

If radium had a well-defined spectrum, it would be a matter of great importance in connection with the determination of the purity of any given sample of its salts. To determine the spectrum, the Curies turned over to Demarçay some samples of material, containing radium, and he studied the spark spectra of these substances. The first sample used by Demarçay contained large quantities of barium. Nevertheless, even with this material he was able to recognize, in addition to the barium lines, a line in the ultraviolet, having a wave length of 3814.7 Angström units. When a purer substance was used the intensity of this line increased, and other lines made their appearance. Finally, a product was obtained of such purity that only the three strongest barium lines appeared at all, and these were of such slight intensity as to show that the barium was present only in small quantity as an impurity. While this product was nearly pure radium chloride, it was still further purified until the strongest barium lines could scarcely be detected at all.

The chief lines of radium found by Demarçay, lying between λ 5,000 and 3,500, are the following—the most intense line being represented by the number 16.

Wave Length.	Intensity.
4826.3	10
4683.0	14
4533.5	9
4436.1	8
4340.6	12
3814.7	16
3649.6	12

The strongest of the above lines have the intensity of the strongest lines of other substances.

In addition to the lines referred to above, and a number of weaker lines, the spectrum of radium contains two bands—the one extending from 4631.0 to 4621.9, having a maximum at 4627.5; the other, a stronger band in the ultraviolet, extending from 4463.7 to 4453.4, having a maximum at 4455.2.

Thus, the spectrum of radium resembles the spectra of the alkaline earths, which consist of strong lines and also bands.

It was pointed out by Mme. Curie that although spectrum analysis is, in general, a very sensitive means of detecting minute quantities of substances, in the case of radium it is far less delicate than the spectroscope, notwithstanding the fact that radium gives a well-defined spectrum.

In order to photograph the strongest spectrum lines of radium, a specimen of the radium-containing barium was required, which had an activity at least fifty times that of metallic uranium.

The electrometer, on the other hand, can detect radium which has an activity that is only one ten-thousandth that of metallic uranium. The electrical method of detecting the pressure of traces of radium is thus at least *five hundred thousand times more sensitive than the spectroscopic.* The spectroscopic method is of importance in connection with the study of radioactivity, not so much as a method for measuring radioactivity, as for determining the purity of the radium in the various stages of its separation from barium. The spectrum of radium prepared by Gietel has been studied by Runge and others. Radium bromide gives a deep-red color to the flame, and the spectrum contains two bright bands in the red, also a line in the bluish-green, and two weak lines in the violet.

THE ATOMIC WEIGHT OF RADIUM.

The atomic weight of radium was first determined by Mme. Curie, with specimens that contained more or less barium. Values as low as 140 were at first obtained. As purer and purer specimens were prepared, atomic weight determinations gave larger and larger values for the atomic weight of radium.

A specimen which still showed the strongest lines of barium with appreciable intensity, gave a value for the atomic weight of the element ranging, for five determinations, between 220.7 and 223.1.

A specimen of radium chloride was then purified until the strongest lines of barium appeared very weak indeed. From the minute quantity of barium that can be detected by the spectroscope, this specimen of radium chloride could contain only the merest trace of barium.

The atomic weight determinations were made by precipitating the chlorine as silver chloride. Taking the atomic weight of silver as 107.8 and chlorine as 35.4; the atomic weight of radium was found to be 225, ranging in three determinations between 224.0 and 225.8.

Light has been thrown on the atomic weight of radium by Runge and Precht, who studied the spectrum of radium in a magnetic field. Series of lines were observed, under those conditions, with radium, that are analogous to those found for the alkaline earth metals —calcium, strontium and barium. Certain relations have been established between the series of lines for the element, and its atomic weight. By means of these relations Runge and Precht have calculated the atomic weight of radium to be 258. Other investigators, however, on purely physical grounds, have concluded that the atomic weight is close to 225. We must, then, decide between these two numbers. In the light of the evidence at present available, this is not an easy task.

The number 225 seems to fall in with the value that radium might be expected to have from the Periodic System. This number would place radium after bismuth with an atomic weight of 208, and before thorium with an atomic weight of 232. The number 225 for its atomic weight would place radium in group II, along with calcium, strontium and barium, to which chemically it is closely allied—especially to barium, as we have seen. The atomic weight 225 also places it in the twelfth series, along with thorium and uranium—the other well-known elements that are radioactive.

On the other hand, the atomic weight 225 places radium in the second group of the Periodic System, while thorium is in the fourth, and uranium is in the sixth. In a word, it places radium *before* thorium and uranium, the atomic weight of thorium being 232.5; and that of uranium 239.5. It will be observed that these three radioactive elements have the *largest atomic weights of all the known chemical elements.* Indeed, an attempt has been made to establish a relation between the relatively large masses of the atoms of these elements and their radioactivity—an attempt which, as we shall see when we come to study the nature of radioactivity, is most praiseworthy. In terms of this relation, the atom with the largest mass should be the most radioactive, and as we usually measure mass by weight, the atom with the largest atomic weight should be the most radioactive. If the atomic weight of radium is 258, it would be in accord with this relation. The atom of radium would be by far the *heaviest* of all known atoms, that of uranium with a mass of 239.5 would be next, followed by thorium with a mass of 232.5.

We shall see later the significance of this relation, and will become so impressed by it in connection with the application of the electron theory of matter to the explanation of radioactivity, that we shall be loath to give it up, and accept a lower atomic weight for radium than for uranium and thorium.

Since writing the above a relation has

appeared to the writer, which somewhat invalidates the argument for 225 as the atomic weight of radium, based upon the Periodic System. If we turn to the Periodic System and examine the atomic weights of any two elements in the same group and in two succeeding series; in a word, of two elements that fall directly under one another, we find that their atomic weights differ from one another by about *twenty-five* units. This is especially true for the elements with higher atomic weights. Take the members of group II, in which radium undoubtedly belongs chemically. The atomic weight of calcium is 40.1, that of zinc 65.4—difference 25.3. Zinc differs from strontium in round numbers by twenty-two points; strontium from cadmium by twenty-five points, and cadmium from barium by twenty-five points. Similar relations obtain between successive members of *every other group* in the Periodic System, especially between the members with the higher atomic weights. The difference between the atomic weights of two elements in the same group, and in succeeding series, is generally around twenty-five.

It will be seen that the difference between the atomic weight of radium as determined by chemical analysis, (225) and as determined by spectrum analysis (258) is thirty-three units.

We have already seen that the number 225 places radium in group II of the Periodic System, and in series twelve. The atomic weight 250 would place radium in group II of the Periodic System, and in *series thirteen.* This may seem surprising since only twelve series have thus far been recognized in the Periodic System. It may be that the proper place for radium is in a *new series,* of which only one number exists, or has, at least, thus far been discovered. If radium has an atomic weight of 250, or thereabouts, it would thus fall in group II of the Periodic System, with its chemically allied elements, just as well as if it had an atomic weight of 225.

The problem of the atomic weight of radium, however, can not be settled by reasoning from analogy, but must be worked out by some direct method.

If we examine the method employed by Mme. Curie for determining the atomic weight of radium, it does not seem to be entirely free from objections. In the first place, the amount of radium chloride that could be obtained, which was of sufficient purity for atomic weight determinations, was necessarily small. Indeed, the total amount of chloride at the disposal of Mme. Curie was only about one hundred milligrammes. This tended to magnify all experimental errors.

The chloride of radium, which is hygroscopic, shown by the fact that it absorbs water when in a desiccator over drying agents, was weighed in a platinum crucible. Further, it is not clear that any test was made to determine whether the crystallized radium chloride did not lose hydrochloric acid when the water of crystallization was removed. It will be recalled that other members of the barium group form oxychlorides, when the chlorides are dehydrated in the air. It is well known that the chloride of calcium can be dehydrated without the formation of oxychloride, only in a current of hydrochloric acid. This is a matter that should certainly receive attention in connection with the method of determining the atomic weight of radium, that was employed by Mme. Curie.

A further question that naturally suggests itself in connection with this method, is this: Does silver nitrate precipitate all of the chlorine from radium chloride as silver chloride? The properties of radium are so remarkable, as we shall learn, that it does not follow that this would necessarily be the case. All in all, it appears to the writer that the question of the atomic weight of radium is still an open one, that can be settled only when a larger amount of material is available, and when other methods can be brought to bear on the problem.

The Final Action on the Harvard-Massachusetts Institute of Technology Alliance.

Dr. Henry S. Pritchett, of the Massachusetts Institute of Technology, has issued the following statement to the alumni and former students:

"At a meeting of the corporation of the institute held on October 11 a report was received from the executive committee, advising the corporation that in the view of the committee the recent decision of the Supreme Court of Massachusetts relative to the land on Boylston street made it impossible for the institute to take further steps in the plan of cooperation with Harvard University which has been under consideration the past year.

"In view of the facts set forth the corporation thereupon adopted a resolution instructing the executive committee to notify the authorities of Harvard University that the institute found itself unable to proceed with the plan of cooperation, and to express at the same time the appreciation of the corporation for the fairness and courtesy with which the authorities of Harvard had joined in this common effort to solve a difficult question.

"The corporation further authorized the president to communicate this result to the alumni, faculty, and friends of the institute, and to invite their hearty cooperation in the future upbuilding of the institute.

"This decision disposes not only of the matter of an alliance, but also, for some time to come, at least, of the question of a site. It seems clear that the institute's home must continue to be, for a number of years, its present one, with such added room and buildings as may be found necessary and practicable. With these questions settled it is clear that the duty of each institute man, of each friend of the institute is to go heartily and enthusiastically at the problems which lie immediately and clearly before us, with the ambition to make the institute the most efficient means possible for ministering to the intellectual, moral and social life of its students. The questions upon which we have honestly differed are now out of the way. Let us now pull together for the solution of our common problems. Some of these problems need to be attacked at once. Outside of the question of increased endowment, which is most pressing, additional land ought to be secured as soon as possible; a site for the Walker Memorial Building must be provided and the building started as promptly as possible; and an additional building such as a chemical laboratory and the erection of one or two modest dormitories on our land in Brookline adjoining the athletic field would serve a great need of the student life. To the solution of these pressing and specific problems the corporation asks your heartiest support and assistance."

American Institute of Electrical Engineers.

The 200th meeting of the American Institute of Electrical Engineers will be held at 44 West Twenty-seventh street, New York, at 8.15 P. M., Friday, October 27, 1905. The general subject to be discussed at this meeting is "Lightning and Lightning Protective Apparatus." The following papers will be presented:

1. "Some Experiences with Lightning Protective Apparatus," by Julian C. Smith, of the Shawinigan Water and Power Company, Montreal.
2. "Performance of Lightning Arresters on Transmission Lines," by A. J. Neall, electrical engineer with the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa.
3. "Lightning Arresters on Italian High-Tension Transmission Lines," by Philip Torchio, chief electrical engineer of the New York Edison Company.

THE ILLINOIS STATE ELECTRIC ASSOCIATION.

ANNUAL CONVENTION AT PEORIA, OCTOBER 5 AND 6.

The sixth annual convention of the Illinois State Electric Association was held at Peoria, Ill., Thursday and Friday, October 5 and 6. The headquarters of the convention were at the National Hotel.

The sessions were presided over by President E. B. Hillman, of Quincy.

Secretary David Davis, of Litchfield, reported receipts of $470, and Treasurer Charles A. Vallette, of Edwardsville, reported a balance of $188.45.

A committee to revise the by-laws, particularly in the matter of the membership status of municipal plants, was appointed. This committee included H. E. Chubbuck, La Salle; S. S. Davis, Moline, and F. W. Little, Peoria.

The afternoon session opened with the reading of a paper by H. B. Gear, of the Chicago Edison Company, on "Underground *versus* Overhead Lines."

The committee on revision of the by-laws reported three amendments, which were adopted. One amendment provides that any member transferring his station to a municipality ceases to be a member. Another requires applications for membership to be referred to a committee appointed for the purpose, and the third amendment provides for the election of four vice-presidents instead of three.

The committee on insurance, consisting of J. J. Frey, Hillsboro, and W. A. Thomas, Abingdon, presented an excellent report. This committee has been peculiarly efficacious in this work.

Mr. E. R. Townsend, of Chicago, an engineer and inspector for the old line fire insurance companies of the state, at the request of Mr. Frey, addressed the association on the subject of "Power-House Insurance" on Thursday afternoon. Mr. Townsend gave the convention a straight talk, setting forth the hazards from the underwriting company's point of view, and gave the central station men a very clear idea of their responsibilities with regard to power-house insurance.

Following the discussion on the matter of insurance, Professor S. W. Parr, of the University of Illinois, read a paper on "The Composition and Heating Values of Illinois Coal."

A paper was then presented by W. R. Pinckard, of the Chicago office of the Westinghouse Electric and Manufacturing Company, on "Interurban Transmission."

Following the reading of this paper, Mr. X. Cavarno, Kewanee; R. S. Wallace, Peoria, and R. H. Abbott, Petersburg, were appointed a nominating committee, and adjournment was taken until Thursday evening.

At the evening session a paper on "Large-Unit Incandescent Lamps for General Illumination" was read by Mr. F. W. Wilcox, of the General Electric lamp works at Harrison, N. J. This paper elicited a very lengthy discussion.

The election of officers was taken up at the Friday session, the following being chosen for the ensuing year: president, D. Davis, Litchfield; first vice-president, J. N. C. Shumway, Taylorville; second vice-president, E. L. Brown, Elmwood; third vice-president, E. McDonald, Lincoln; fourth vice-president, E. H. Gray, El Paso; treasurer, W. J. Day, Bement; secretary, H. E. Chubbuck, La Salle. Executive committee—W. B. McKinley, Champaign; E. G. Schmidt, Springfield; F. J. Baker, Chicago; S. S. Davis, Moline; E. B. Hillman, Quincy.

There was a large attendance of delegates and visiting electrical men, and a number of manufacturers made interesting exhibits and were represented by their sales and engineering departments. Among these companies were the following: Westinghouse Electric and Manufacturing Company, Peoria Gas and Electric Company, General Electric Company, Nernst Lamp Company, Allis-Chalmers Company, Fort Wayne Electrical Works, Wagner Electric Manufacturing Company, Bryan-Marsh Company, Ewing-Merkle Electric Company, American Circular Loom Company, Columbia Incandescent Lamp Company, American Electric Supply Company, Central Electric Company, Moline Lamp Company, Stanley-G. I. Electric Manufacturing Company, Monarch Electric and Wire Company, Western Electric Company, Electric Appliance Company, Maloney Electric Company, American Conduit Manufacturing Company, Switchboard Equipment Company, D'Olier Engineering Company, National Electric Lamp Company, Diamond Meter Company, and Electric Storage Battery Company.

New American Locomotive Company Directors.

C. A. Coffin, president of the General Electric Company, and E. C. Converse, a director of the United States Steel Corporation, have been elected directors of the American Locomotive Company to succeed W. Seward Webb and George W. Hoadley.

The Madison Square Garden Electrical Show.

The managers of the Madison Square Garden Electrical Show, to be held in New York, December 11 to 23 inclusive, report that during the past week the Electro-Dynamic Company, Magnetic Wire Company, Waterbury & Company, Vandyck Churchill Company, Gold Car Heating Company, New York city, the Stow Manufacturing Company, of Binghamton, N. Y., and the Magneta Clock Company, of Zurich, Switzerland, have arranged for exhibits.

"The Street Railway System of the Borinage."

TO THE EDITOR OF THE ELECTRICAL REVIEW:

In your issue of September 23, 1905, you published an article by Dr. A. Gradenwitz, describing a single-phase street railway in Belgium.

The author mentions that Winter-Eichberg motors are used on the above street railway line. I want simply to remark that according to an agreement entered into by the Allgemeine Elektricitäts Gesellschaft, of Berlin, two years ago, the single-phase motors of that line are considered to be built under the control of my Belgian patents.

MARIUS LATOUR.

Schenectady, N. Y., October 10.

Peter Cooper Hewitt at the New York Electrical Society.

The 253d meeting of the New York Electrical Society will be held at the auditorium of the New York Edison Company, 44 West Twenty-seventh street, New York city, Monday, October 23, at 8 P. M. Mr. Peter Cooper Hewitt will lecture on "Electrical Reactions of Gases." This latter-day development of electrical phenomena has excited intense interest, and the work of Mr. Hewitt has been particularly brilliant. The lecture will take up the electrical reactions of gases, with particular reference to the phenomena found in the Cooper Hewitt mercury vapor lamp and rectifier. Mr. Hewitt classifies the electrical reactions or resistances as those appearing at the positive electrode, at the negative electrode and in the intervening vapor path. He will direct attention to the difficulties of obtaining independent measurements of the different resistances. The visible phenomena will be studied, and the various characteristics of this apparatus will be discussed.

The Largest Hydroelectric Installation in Southern Asia—II.

Electricity for Industrial Purposes in India.

By A. C. Hobble.

THE three exciter units are four-pole, seventy-five-kilowatt machines, operating at 465 revolutions per minute and over-compounded from 110 to 115 volts at no load and full load respectively. With a power-factor of ninety-five per cent one exciter is capable of supplying the necessary generator field excitation with a station load of 5,500 kilowatts. Since the ultimate total output of the plant is between 6,500 and 7,000 kilowatts it will be necessary to operate two exciters in multiple. The third exciter unit is a reserve, being operated, however, during the night for station lights. Herewith is reproduced the wiring diagram of the three exciter units, showing also the arrangement for supplying station lights from any one of the three units. All wires and cables leading from the generators and exciter units through the long stone cable duct to the transformer station on top of the bluff are lead-covered.

INTERIOR OF TRANSFORMER STATION AT SIVASAMUDRAM, SHOWING LOW-TENSION SWITCHBOARDS AND POWER TRANSFORMERS.

STEP-UP TRANSFORMER STATION AND EQUIPMENT.

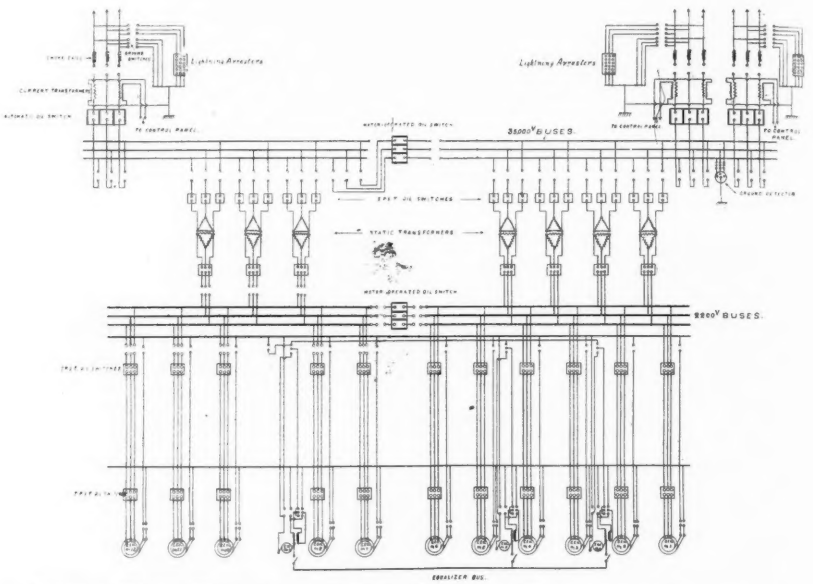
It is due to the fact that the generating plant is situated in a very feverous locality that it was decided to locate the transformer station on top of the bluff (400 feet above the generating station), thus making it more habitable for the switchboard attendants. Hence, all of the essential switching and controlling apparatus is located in the transformer station, 1,000 feet distant from the power-house.

The general wiring diagram for both generating station and transformer house is shown here and needs but little explanation. The generator voltage, varying between 2,000 and 2,250, according to the load, is raised to approximately 35,000 volts through seven banks of 350-kilowatt General Electric air-blast transformers. The transmission voltage was formerly 30,000, but during the second installation and owing to increase of power to be transmitted the line pressure was raised to 35,000 volts by replacing the 30,000-volt coils with new ones wound for the higher voltage. In this way and through

other means to be described herein, the line loss has been kept at a reasonable value.

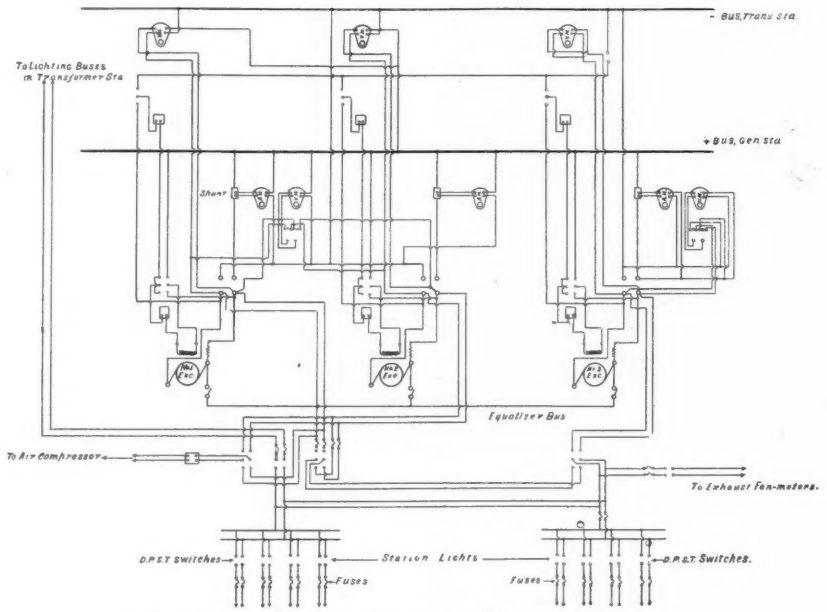
The low-tension switchboard, consisting of eleven generator, two direct-current exciter, seven transformer bank, two total output, two line switch control, two voltage regulator, and five local panels of blue Vermont marble, is situated on the main floor, or second deck of the three-deck arrangement. The 2,200-volt oil switches, bus-bars and disconnecting switches are located on the ground floor, while all of the high-tension switching apparatus, with exception of transformer oil switches, is located on the third floor or gallery. In addition to the usual voltage, power and current meters on the low-tension switchboard are also two frequency meters, two synchronizing instruments and one power-factor meter.

The accompanying sketch is the wiring diagram of the synchronizing arrangement for both generators and the two sections of the 2,200-volt buses. This latter feature is one to which particular attention is called. From an examination of the switching arrangement as shown in the wiring diagram for both raising and lowering transformer stations, the flexibility of the whole scheme is apparent. The plant may be operated as a whole or as two separate plants, as desired. Repairs may be made with facility without disturbing the general operation of plant. Many prominent engineers consider desirable, as a means of increasing reliability and continuity of service and the factor of safety against complete shutdowns of plant, the operation of the same as two entirely separate plants. Provided the power plant is being operated in this way, it is easy to unite the two sections quickly as one by synchronizing the low-tension buses at the generating end of the transmission lines. This is made possible by the quick-acting, 2,200-volt, motor-operated oil switch located between the two sets of low-tension buses.



General Wiring Connections in Power-House and Transforming Station at Sivasamudram.

On starting up the plant after a complete shutdown due to any cause, much time and trouble is saved by synchronizing all of the generators at the same time. This is accomplished by closing the mains and field switches of all of the generators and then closing the main exciter field-switch, taking care beforehand to have all rheostatic resistance "cut in" in both generator field and exciter field circuits. The voltage is gradually brought to normal by turning out resistance from the exciter field circuits. To assist the hydraulic operator in the generating station in holding the correct speed for paralleling alternators a synchronizing lamp is located on each generator panel. The switchboard attendant in the transformer station above throws the machines in parallel at the proper moment indicated by the pointer on the synchronizing instrument.



Exciter Wiring Arrangements and Station Lighting.

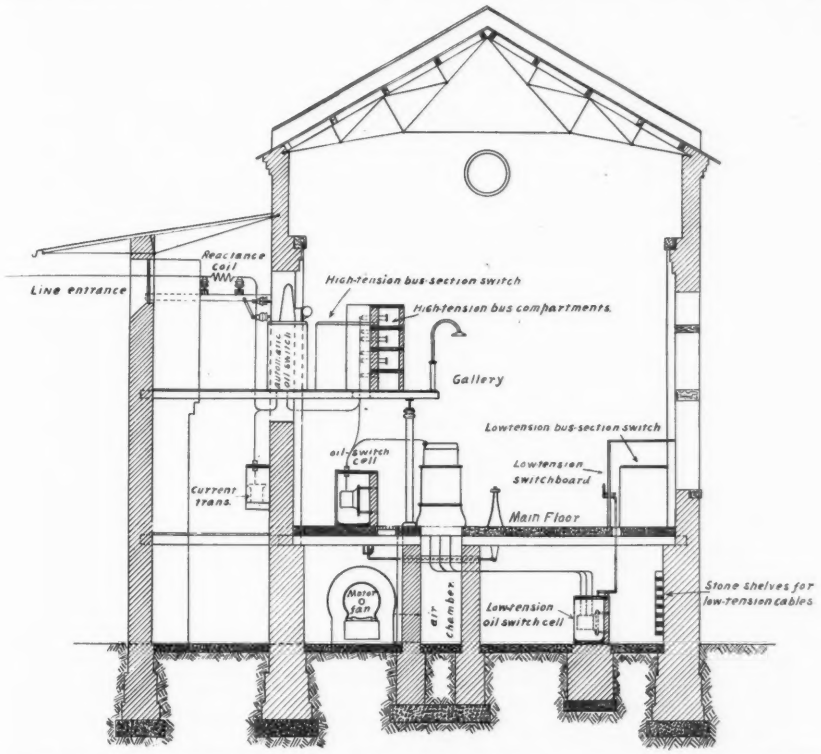
The old high-tension switchboard is composed of six double-line switch panels, twelve transformer switch panels, and one panel upon which is mounted a three-phase electrostatic ground detector. All are of blue Vermont marble, supported by a heavy wooden framework, allowing three feet to each phase. On the new high-tension side of the transformer station a cheaper construction is employed, using brick compartments for the complete enclosure of the three high-tension bus-bars and for separating the air-break knife-switches which are connected in series with the 35,000-volt, single-pole, double-break transformer oil-switches. All of the high-tension transformer oil-switches are located in brick compartments on the main floor. All of the oil-switches in use have given entire satisfaction and those which have had three years continued service have received no renewal of oil. A particular feature to be commended in the recent extension of the original installation is the location of high-tension

and low-tension controlling switches within the immediate reach of the switchboard attendant.

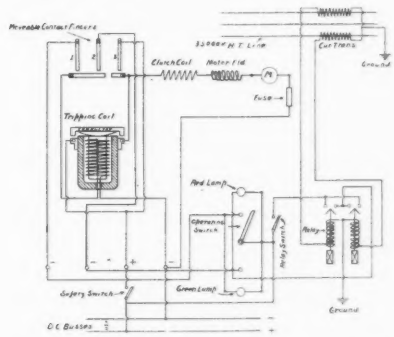
In each transmission line at the generating end is an automatic motor-operated, 35,000-volt, double-break oil-switch. These are adjusted to trip at slightly over 100 per cent overload current by the action of an automatic bellows-type, time-limit relay. The time-limit mechanism of the latter is very simple and effective. The relay plunger, which is also the iron core of the solenoid, is actuated against air pressure by the line current. The time limit depends upon the strength of line current or percentage overload, and the adjustment of the valve which controls the escapement of air from the receiver. A diagram of the wiring scheme of the electrically operated oil switches, with time-limit relays, is here reproduced. With this arrangement, supplemented by the use of time-limit bus-section switches at the Kolar gold field transformer station, a heavy overload or a short-circuit on one of the duplicate transmission lines actuates the time-limit relay oil-switch in the faulty line, thus switching it out of service, while the station output is carried on the other line until the fault is located. This is accomplished by the aid of a 350-kilowatt, line-testing transformer, which will be more fully described later on. All of the motor-operated oil switches are actuated by remote control switches, located on the line-control switch-panels of the low-tension switchboard.

Another, a new and valuable feature adopted in the extension to the original plant, is the use of two General Electric voltage regulators. The wiring diagram of one regulator is shown in the accompanying drawing. Owing to the wide range of voltage to be controlled—ninety-three volts at no load to possibly 115 volts at full load—it was found necessary to operate the two regulators in multiple; one being adjusted for the low-voltage range, the other for the higher voltage. As the load gets beyond the limit of voltage control of one regulator, the other is immediately switched into service. The action of the regulator is apparent from a glance at the wiring diagram. An increase of load tends to lower the voltage and increase the line loss. The direct-current control magnet excited from the direct-current fuses and the alternating-current magnet excited from the 2,200-volt bus-bars, acting in conjunction, tend to maintain a constant voltage at the transmitting station. This, however, is not sufficient; since, owing to a variable line loss, the desired constant voltage at the receiving station, ninety-two miles distant, does not pertain. To overcome this difficulty a second winding, excited from the transmission line or high-tension buses through a current transformer inserted therein, compensates for line loss regardless of phase relation. To accomplish this it is necessary to have the requisite amount of rheostatic resistance in the shunt-field circuit of the exciters. The differential relay magnets perform the office of cutting in and out this resistance. Their action depends upon the "make" and "break" of the circuit controlled by the direct and alternating-current magnets above mentioned, and through which their actuating current is obtained.

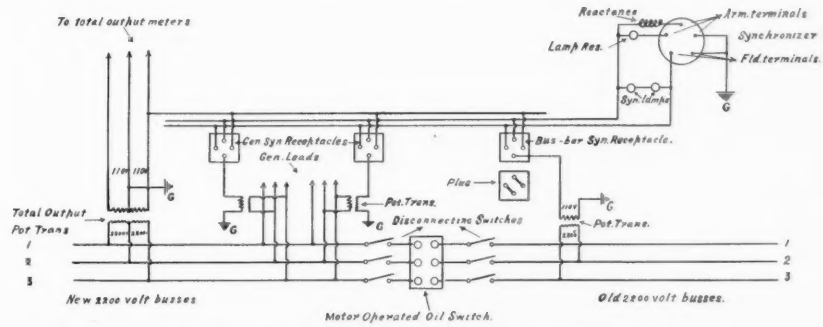
The regulator acts upon the slightest change of load and keeps the voltage constant at the distribution end of the line. Acting in conjunction with the water-wheel governors it performs a valuable service in preventing the line volt-



Cross-Section Showing General Arrangement of Apparatus and Switch Compartments in Transmitting and Receiving Transformer Stations.



Wiring Scheme of Electrically Operated Oil Switches with Time-Limit Relays.

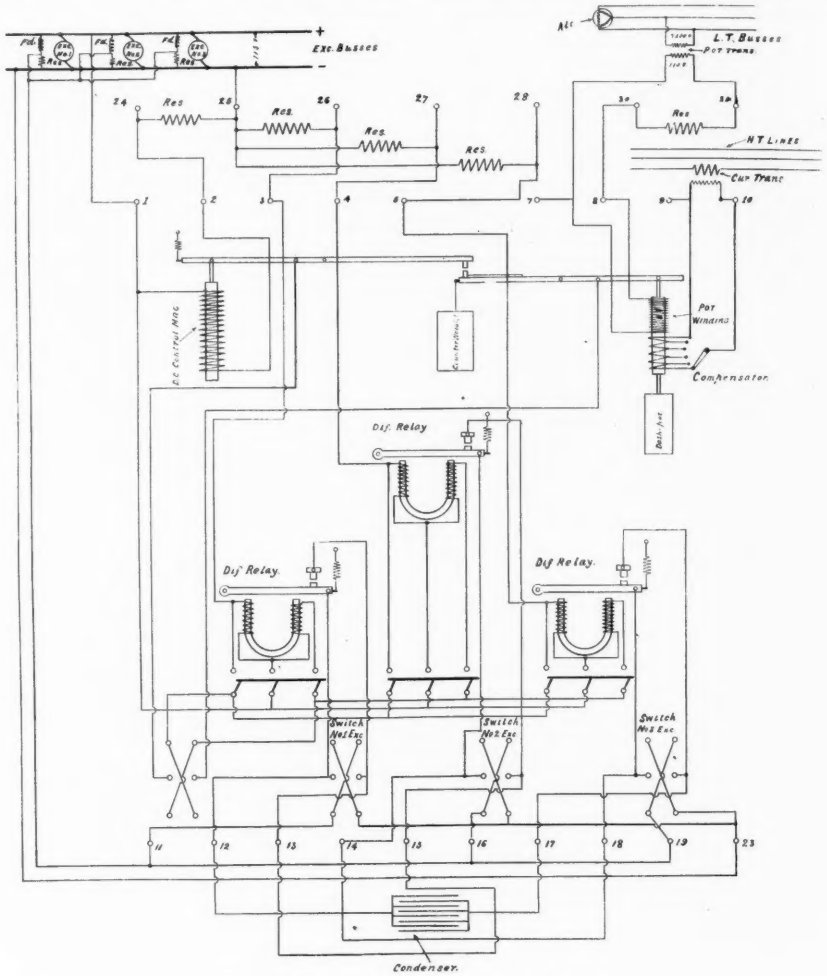


Generator and Bus-Bar Synchronizing Arrangement.

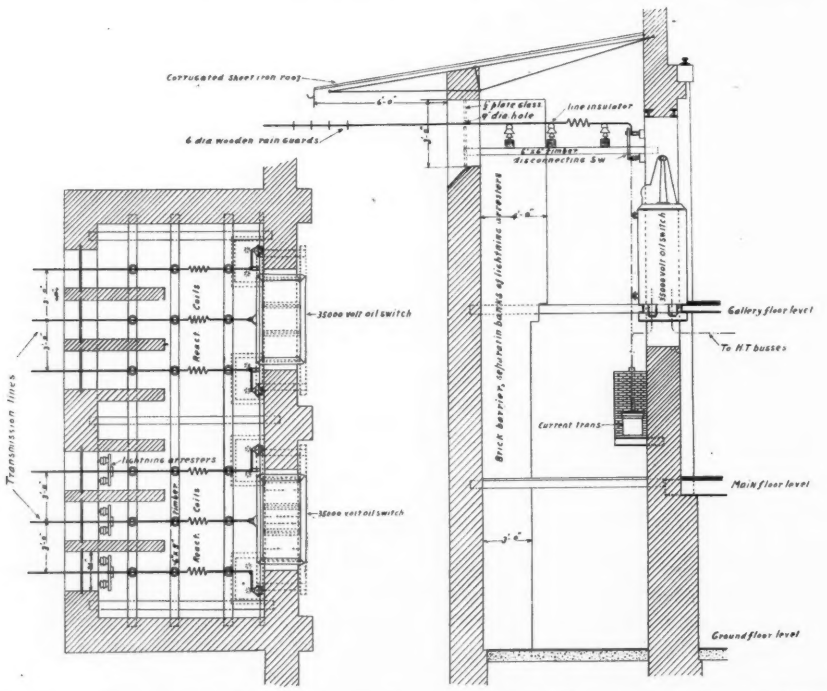
age from reaching a dangerous value when the entire station load at the receiving station is suddenly switched off for any reason. One, two or three exciters may be operated singly or in multiple on each voltage regulator.

Herewith are shown the curves of line voltage and current from no load to full load at approximately power-factor ninety-five at the transmitting station with varying line loss conditions. Although the line voltage at the transmitting end varies approximately between 29,760 and 37,000 from no load to maximum, the voltage in the lowering transformer station at Kolar remains practically constant at 29,702. Thus with both Kolar transmission lines in operation, the line loss varies from 702 volts at no load to approximately 6,000 volts at full load for power-factor ninety-five, at the transmitting end of the line. This means a line loss of approximately fifteen per cent at normal load.

Separate wire towers are annexed to the main transformer building for outgoing transmission lines, lightning arresters, reactive coils, and line disconnecting switches. A plan and sectional elevation showing the line entrances and method of anchoring the wires securely inside is given herewith. Outside of the towers, fifteen feet from the outer wall, is an additional pole structure for anchorage reenforcement. This method of anchorage and entrance of the 35,000-volt transmission wires has proved effective and satisfactory in every way. There is no reason why this method should not prove as effective for 60,000 volts or even higher voltages. High velocity winds and violent driving rain-storms are prevalent in this country dur-



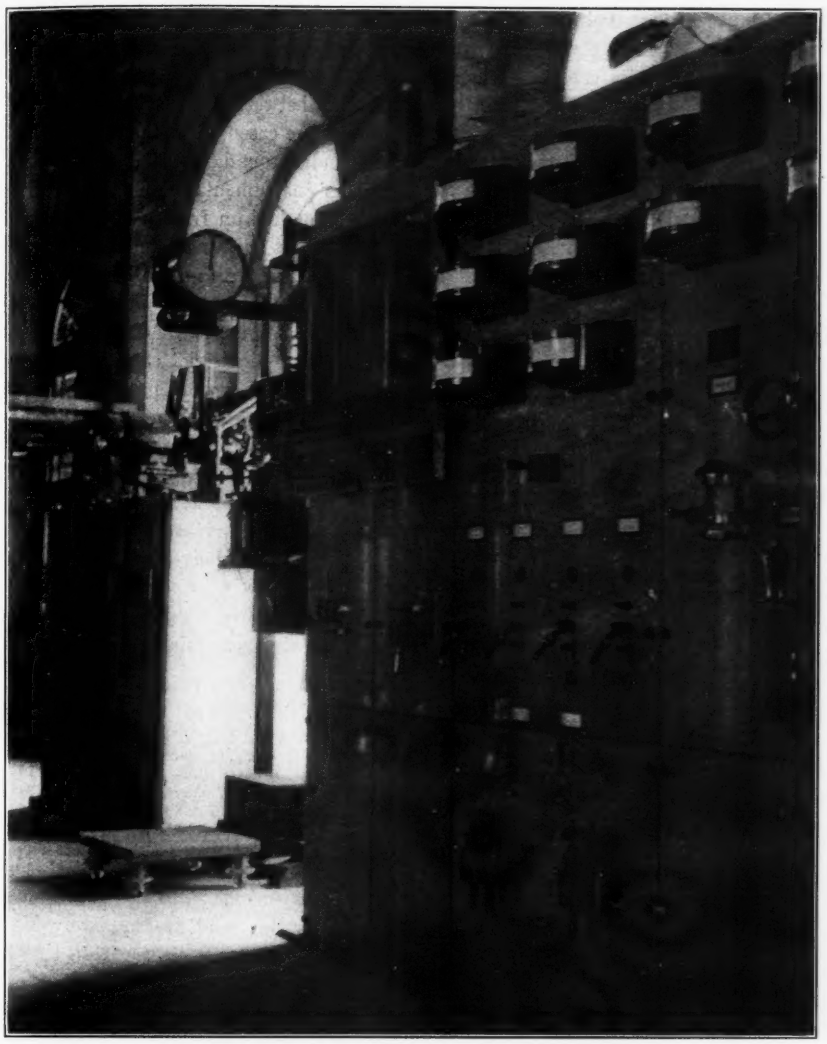
Wiring Diagram of Voltage Regulator.



Plan and Elevation of Line Entrance Tower, Showing Method of Anchoring Line Wires, Location of Lightning Arresters and Reactance Coils.

ing monsoon weather; so that this method has been subjected to very severe tests. A feature not to be overlooked is the apparent abnormal roof extension and the relative position of the rain guards, consisting of six-inch flat wooden discs, with respect to the same. More trouble has been experienced with the numerous low-tension distribution lines at Kolar than with the transmission lines during violent winds and rain-storms, as regards preventing the driving rain from entering the distribution towers.

Reactance coils have been inserted in each phase of the transmission lines between the banks of lightning arresters and the high-tension bus-bars. It has been a much-argued question among electrical engineers as to whether such coils are of real value as protective devices. Experience, in general, has tended to show that they are a valuable adjunct to any electric transmission plant subjected to the effects of violent electrical storms. In this particular climate during a few months of the year violent electrical storms are of fre-



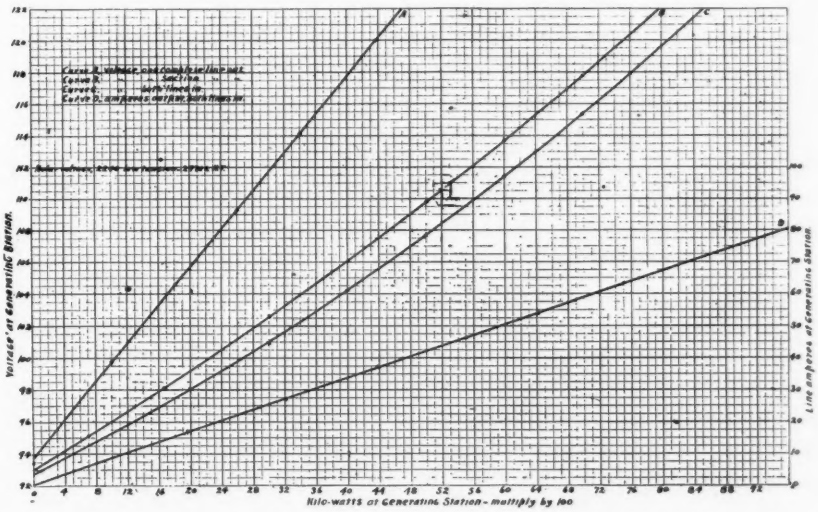
VIEW OF AUTOMATIC REGULATOR AND OIL-SWITCH CONTROL PANELS, 2,200-VOLT OIL-SWITCH IN BACKGROUND, LOW-TENSION SWITCHBOARD, SIVASAMUDRAM.

quent occurrence. During two and one-half years of continued service without the use of reactance coils three transformers have been damaged by heavy lightning discharges. In each instance the discharge occurred inside the top of the transformer case from one of the high-tension leads to the iron case, a distance of from four to five inches. In each case the transformer winding served the purpose of a reactance coil. The lightning arresters were adjusted to discharge at a voltage not exceeding ten per cent above that of the transmission voltage.

Naturally the simplest remedies suggested are additional transformer insulation and the insertion of properly designed reactance (often termed "choke") coils between lightning arresters and transformers. Since the latter suggestion has been effected, we have experienced several severe electrical storms causing discharges to earth through the lightning arresters without disturbing the operation of the plant. At this time the arresters were adjusted to discharge at about twenty-five per cent above normal line voltage. It is a good plan to keep a check upon the action of the lightning arresters by the insertion of "tell tale" slips of paper or thin cards between the knobs of arresters nearest the earth connection. An idea of the severity of the discharge may also be gained in this way. A slight discharge will produce a series of tiny punctures in the card which are scarcely discernible with the unaided eye, while a heavy discharge will produce a single large puncture in which the edge of the whole is charred. The reactance coils herein referred to consist of a simple helix of bare copper wire one size larger than the line wire. The coils are about six inches in diameter, having twenty turns with one-quarter-inch air insulation between them.

It has been found that ordinary static discharges between brass cylinders of lightning arresters has produced a copper nitrate ($CuNO_3$) deposit in the air-gap between them to such an extent as to reduce the air-gap resistance several thousand ohms. This accumulation of copper salt occurs only between some six or eight of the brass cylinders located nearest the transmission wires. The deposit is probably due to the fixation of nitrogen from the air by the static discharge, and the presence of moisture with nitrogen peroxide (NO_2) results in the formation of HNO_3, the reaction of which in the presence of copper produces copper nitrate. Tinning the affected brass cylinders stops the reaction and solves the difficulty.

(To be continued.)



CURVES OF LINE VOLTAGE AND CURRENT FROM NO-LOAD TO FULL-LOAD.

Berlin's Telephone System.

According to Consul-General Mason, of Berlin, the telephone service of the German capital is well worth study. It has grown to enormous dimensions and has features that will strike many as desirable. He writes:

"The telephone system at Berlin is a

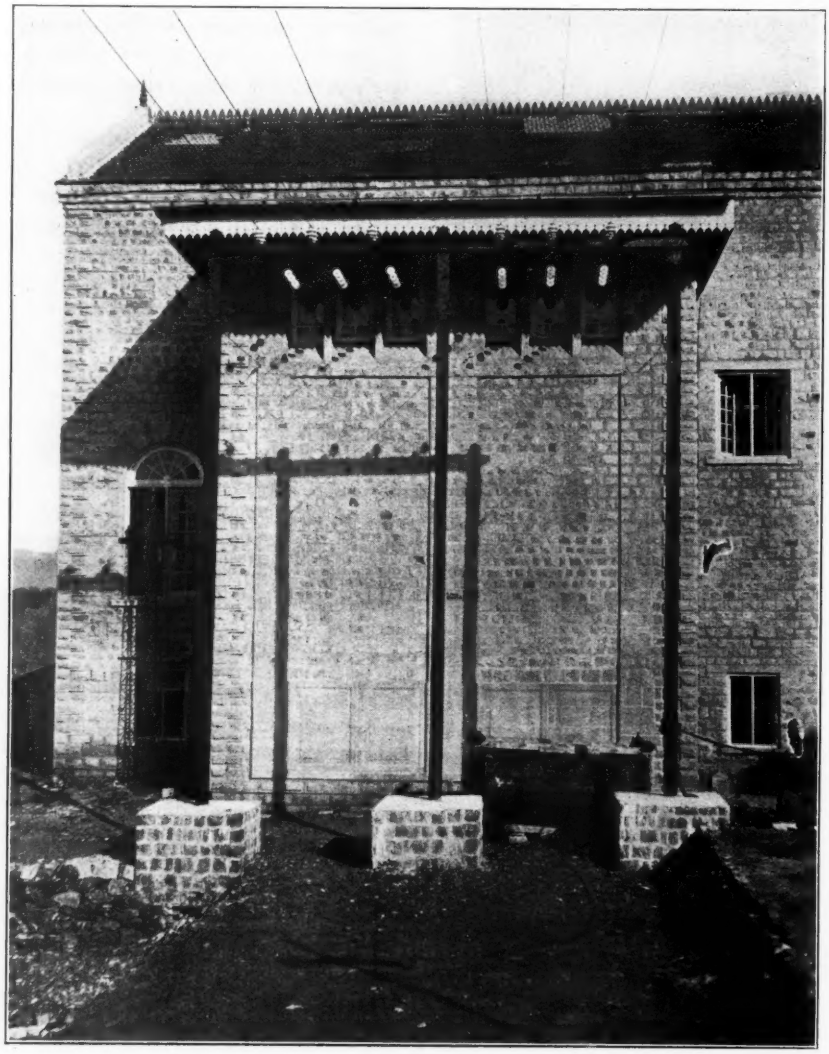
branch of the imperial postal service, and is administered throughout by employés of the government, who hold their positions for life or during good behavior, and receive pensions when they finally retire by reason of old age or disability. From a beginning somewhat tardy, in comparison with other large European and American cities, the service here has grown to one of the largest in the world, not less than 86,000 telephones being now installed in the public system of greater Berlin. The long-distance telephone service of this city embraces within its scope more than 2,600 cities and towns in Germany and other European countries, including capitals like Paris, Brussels, Rome, Vienna, and St. Petersburg. For this branch of the service the central telephone bureau is equipped with a staff of operators, mostly women, who are competent in the various European languages. The short-distance service includes the city of Berlin proper, which is divided into nine districts, each with its central exchange, and eighteen branch exchanges in the various suburbs within a radius of five miles from the central station in Berlin.

"The cost to subscribers per annum for a telephone installation in Berlin is from 180 to 200 marks ($42.84 to $47.60) while for certain suburbs, where the instruments are less frequently used, the cost varies from eighty marks ($19) at Adlershof to 140 marks ($33.32) at Steglitz, and 160 marks ($38.08) at Westend, which is the extreme western section of Charlottenburg. The largest number of instruments embraced in one district or exchange is District or 'Amt' I, with 13,538 connections; next come Amt IV with 12,884, and III with 10,503. In the organization of the various exchanges one female operator is required to attend to the calls of from 100 to 200 telephones. The operators are carefully educated and selected, ably directed, and are for the most part alert and efficient. The connections between the various district exchanges are cased in earthenware conduits laid underground, but the wires to subscribers' instruments are mainly strung on high wrought-iron frames set on the roofs of the tallest buildings, and are never permitted in any positions so low as to interfere with the fronts of buildings or the traffic of the streets. At all the branch post offices and district exchanges, as well as at various other prominent places throughout the city, are automatic public telephones, which any person may use after dropping in the slot a ten-pfennig piece, the value of which is two and one-half cents in American currency.

"The rates for long-distance service are as follows for a communication which does not exceed in duration three minutes. The following schedule includes only Germany:

To All Places within a Radius of	Cents.
15 miles	5
30 "	6
63 "	12
315 "	24
625 "	48

"The rates for telephone service to foreign countries are specially arranged with the governments of the several neighboring nations, and are relatively higher than those between points within the German empire."



VIEW OF LIGHTNING ARRESTER TOWER AND OUTGOING TRANSMISSION LINES, TRANSFORMER HOUSE, SIVASAMUDRAM.

An Explosion Gas Turbine.

A brief description of an explosion gas turbine, for which a British patent has been obtained by M. Heinrich Zoelly, is given in the *Mechanical Engineer* (London), September 30. In earlier proposals for gas turbines an explosion is caused to occur in an enclosed chamber, and the resulting gases are directed through a nozzle against the blades of a turbine. In this system the pressure, and hence the velocity, of the jet vary between explosions, while for maximum economy the pressure should remain constant. Herr Zoelly's system endeavors to get around this difficulty by injecting steam into the pressure chamber at such a rate as will maintain the pressure constant between explosions. This steam is obtained from a generator which is heated by the exhaust gases, and the rate at which the steam is admitted into the chamber is controlled automatically by the speed of the turbine. In this system it is necessary to prevent premature explosions, a result which is accomplished by opening the air valve before admitting the gas. Thus a cushion of air is interposed between the waste gases and the new mixture.

The Power Station.[1]

By Fred N. Bushnell.

SINCE the advent of the direct-connected generator, the tendency in power station design has been toward a more systematic and compact organization of the generating apparatus and the utmost simplification of the entire plant consistent with the highest efficiency. The practice of different engineers has gradually worked toward a type of station which is now so generally adopted for street railway work where limitations are not placed upon the design by the size or shape of the available site, that it can fairly be said to represent standard practice in modern power station engineering. It embodies the following essential principles:

1. Simplicity of design.
2. Subdivision of the plant into separate sections, so as to localize the effect of trouble to any part of the generating apparatus.
3. Provision for the symmetrical extension of the plant to provide for future power requirements.

This station in its simplest form consists of a boiler room, engine and generator room, and switchboard gallery, arranged in parallel lines and separated from each other by substantial fireproof walls. In stations of very large size the boilers are frequently arranged in two tiers, or in groups, each group having its own chimney and flues and independent systems of feed and steam piping. This arrangement of the station is now generally referred to as the unit system, the distinguishing feature of which is that the boilers, engines and generating apparatus are arranged in separate units or groups, each one of which embodies all of the essential features of a complete generating plant, and the great advantage of which lies in the fact that trouble with any single piece of apparatus is localized, so that its effect is felt only in that unit of which it forms a part. Provision for carrying the load in the event of a breakdown of any important part of the apparatus is made by installing an additional or spare unit.

While the unit system is now almost universally employed in the larger power stations, it is usually somewhat modified for smaller plants where the liability to interruption of the service is not so great or the results so disastrous, the chief difference being in the arrangement of the steam and feed piping. The steam piping from the boilers is run to a longitudinal header, from which the connections to the engines are taken off at convenient points. This steam header is divided into sections by means of gate valves, which permit of any section being cut out at the convenience of the operator for the purpose of making repairs. Usually two systems of feed piping are provided, one of which supplies hot water to the boilers through the heaters and economizers, while the second, or auxiliary system, supplies cold water, or water direct from the heaters, in case of trouble with the main system. This arrangement of piping provides sufficiently against interruption in small and medium-sized plants, and in a system carefully laid out with due consideration for the troubles which are likely to arise, it is hardly probable that the disarrangement of any one part will cause serious interruption of the service.

At the present time alternating-current generating stations and distributing systems are regarded as the most efficient to install in large cities where heavy traffic is distributed over a very large area, requiring current to be delivered to the line at a number of points, and where the interest upon the investment in direct-current feeders and cost of their maintenance would amount to more than the same charges plus the conversion losses in an alternating-current system; and for long suburban or interurban railways where the power required at any one point is small as compared with the total power generated. The use of alternating-current apparatus has steadily increased since its introduction, until at the present time approximately sixty per cent of the total power used by electric railways in the United States is generated by this type of apparatus.

In cities where the bulk of the business is within the economical radius of distribution for direct-current lines, and where direct-current generators form the larger part of the present equipment, the common solution of the problem is to use this type of apparatus for city work, adding alternating-current apparatus to supply the more distant portions of the system, or roads operating through outlying districts.

There is undoubtedly a great advantage in having all the apparatus of a uniform type. This simplifies the wiring and switching part of the electrical equipment and permits of a more efficient distribution of the load in the station. But there can be no conversion of energy without loss, and in cases where a considerable part of the system can be supplied with direct current without the use of rotary converters, the composite type of station will frequently be found to offer advantages in lower first cost and higher efficiency.

The location of the power station, its general character, and the type of apparatus to be installed, depend to such an extent upon local conditions, that it is difficult to offer suggestions covering these points except in a general way.

If possible, the station should be located near an ample supply of water for condensing purposes, in order to secure the advantages from the use of the most efficient types of steam apparatus, and if possible, convenient also to a steam railroad or tide water where the coal can be received and handled for the least expenditure of labor. Its location in reference to the distributing system will depend upon the extent and type of the system employed. If the direct-current system is used, it will be desirable to select a location as near as possible to its centre of gravity, in order to reduce the investment in copper, but in the case of an alternating-current distributing system, this is of less importance, and greater consideration will be given to the cost of the available site, the nature of the soil, cost of foundations, etc.

The building should in all cases be of fireproof construction and of neat and attractive design, appropriate to and suggestive of the purpose for which it is used. In determining upon the dimensions of the building, it is important that ample room be provided for all of the apparatus to be installed, so as to avoid unnecessary crowding. Passageways should be provided between each battery of boilers, and at the rear for the convenience of attendants in cleaning the tubes and connections and for making necessary repairs. Sufficient room should also be provided around each piece of apparatus in the engine room so as to enable the attendants to inspect it regularly and keep it thoroughly clean, and to provide for the removal of any part in case of repairs.

In large cities, where land is extremely

[1] Paper read before the American Railway Mechanical and Electrical Association, Philadelphia, Pa., September 25-28, 1905.

valuable, or the available area limited, the amount of power which can be generated per unit of ground area occupied is frequently the controlling factor in deciding upon the power station plans, and in such cases it is not always practicable to provide all of the space usually regarded as desirable for the convenience of attendants. This condition rarely exists, however, except in the larger cities, and in a great majority of cases no excuse can be offered for crowding the machinery to such an extent that it can not be kept in proper condition and conveniently repaired by those responsible for the management of the plant.

Cleanliness is absolutely essential to the successful operation of an electric railway power station. It is necessary that the building itself be kept free from oil and dirt, and each piece of apparatus thoroughly clean at all times, in order to maintain it in its highest state of efficiency. The designing engineer should contribute his share toward this result by providing ample light throughout the building—boiler room as well as engine or generator room. All the walls of the building should be painted in some light shade, preferably with some kind of enamel paint which can easily be washed down and kept clean. This will be found to reflect the light into dark corners of the building or spaces around the machinery which might otherwise form receptacles for dirt and rubbish. It will add very much to the cleanliness and general appearance of the plant, and will contribute toward its successful running.

In designing a power station, the primary object in view is to deliver power at the bus-bars for the least expenditure of money, due importance, of course, being given to reliability of operation, which is the controlling principle in power station work. The fixed charges—interest, depreciation, insurance and taxes—should be as carefully considered as the cost of fuel, labor, supplies, repairs and other items which make up the operating expenses. Consideration should be given to each of these elements in proportion to its importance as a factor in the cost of power. In the great majority of cases fuel is the most important item of expense, frequently amounting to more than all other operating costs combined, and the perfection of those details of design and management which will effect the greatest economy in its use will usually make the best return for the time and labor expended.

Electrical apparatus has now been developed to such a state of perfection that in a well-designed and carefully managed power station over ninety per cent of the power of the engines is converted into electrical energy and delivered to the transmission system for the operation of cars. It appears, therefore, that no very great gain in coal economy is to be expected from the further improvement of electric generators or switching apparatus, and engineers are directing their efforts more than ever before to the steam portion of the power station, which offers a more promising field for a reduction in the cost of power.

The number and size of units to be installed is one of the most important problems bearing upon fuel economy which the engineer is called upon to solve. In order to obtain the maximum efficiency from the prime movers and their auxiliaries, it is necessary that they should be proportioned to the load they are intended to drive, so that if possible they may be operated at all times at or near their rated capacity.

In electric railway power stations it is not regarded as practicable to change the speed of the air or circulating pumps, or to alter the quantity of cooling water, to suit the varying loads upon the station, and these auxiliaries are usually operated at a point sufficient to take care of the maximum load. The power required to drive them is, therefore, practically constant, and their steam consumption per unit of output will vary indirectly as the load on the main engines. Under ordinary operating conditions, where the exhaust steam is used for heating the feed water, only about twelve per cent of the heat in the total steam generated can be used for this purpose, and all steam used by the auxiliaries in excess of this must go to waste; and it follows that in addition to the losses due to the reduced efficiency of the prime movers at light loads, the percentage of loss in the auxiliaries will increase very rapidly as the load upon the main engine decreases, and the best economy of the entire plant will be obtained only when the engines are operated at or slightly above their rated capacity.

The writer has before him the operating statistics of two railway power stations, a comparison of which illustrates the importance of proper attention to this subject. For convenience they will be referred to as Station A and Station B. Both stations furnish power for suburban railways upon which sufficient cars are run to provide a fairly uniform load during the greater part of the day, although subject to more or less violent temporary fluctuations. The general designs of these stations and their equipments are such that the fuel used per kilowatt-hour should be practically the same, provided the engines could be kept well loaded in both cases. In Station A there are three units, and the load conditions are such that one unit is operated during the night and early morning, when the travel is light; two are operated during the greater part of the day, and three at the peak of the load, which occurs shortly after six o'clock in the evening. By careful attention to the changes in the load, it is always possible to keep the running engines fairly well loaded.

In the case of Station B there are two units. The load at night and early morning is very light, so that the engine used is only about half loaded for this period, whereas for the greater part of the day the load is a little more than one engine should be required to carry, and it is therefore necessary to run both engines. The result, of course, is that the average load on the station is only a little more than fifty per cent of the rated capacity of the running engines, and they are consequently extremely wasteful of steam; and, too, the exhaust from the auxiliaries is probably quite a little in excess of that required to heat the feed water, which will also account, in a measure, for the low efficiency of the plant. Five pounds of coal per kilowatt-hour is the record of this plant, as compared with 3.8 pounds for Station A. The greater part of this discrepancy is undoubtedly due to the more efficient load conditions in the latter station. It is probable that had a storage battery been added to the equipment of Station B, the load on the engines could have been regulated so as to have made a much better showing in coal consumption, but it is still problematical if there is any net gain from the use of storage batteries in railway work, and the writer is disposed to think that the use of three smaller engines in place of two larger ones would have been the proper solution of the question. Undoubtedly a saving in coal of from fifteen to twenty per cent would have resulted from the use of engines better proportioned to the load.

In deciding upon the number and size of units, therefore, it is necessary that a careful study should be made of the load conditions throughout the entire day. In providing an increase of power for existing roads, data will be available from

which station load curves under varying conditions of traffic can be constructed, and a fair average decided upon as the basis for determining the size of the units. In the case of a new railroad proposition, this information will be more difficult to obtain, and an approximate load curve will have to be constructed from a study of all the conditions bearing upon the subject. This involves decisions upon the details of the feeder system or train schedules definitely decided upon. In such cases the engineer will have to apply such data as he is able to obtain from other roads in which the conditions of track and the operating conditions are similar. But such data should always be used with the utmost caution, as vital differences in grades, in the feeder system, or in train schedules, must necessarily exist, which will render it extremely difficult to make comparisons sufficiently accurate for a final decision upon the size of the station.

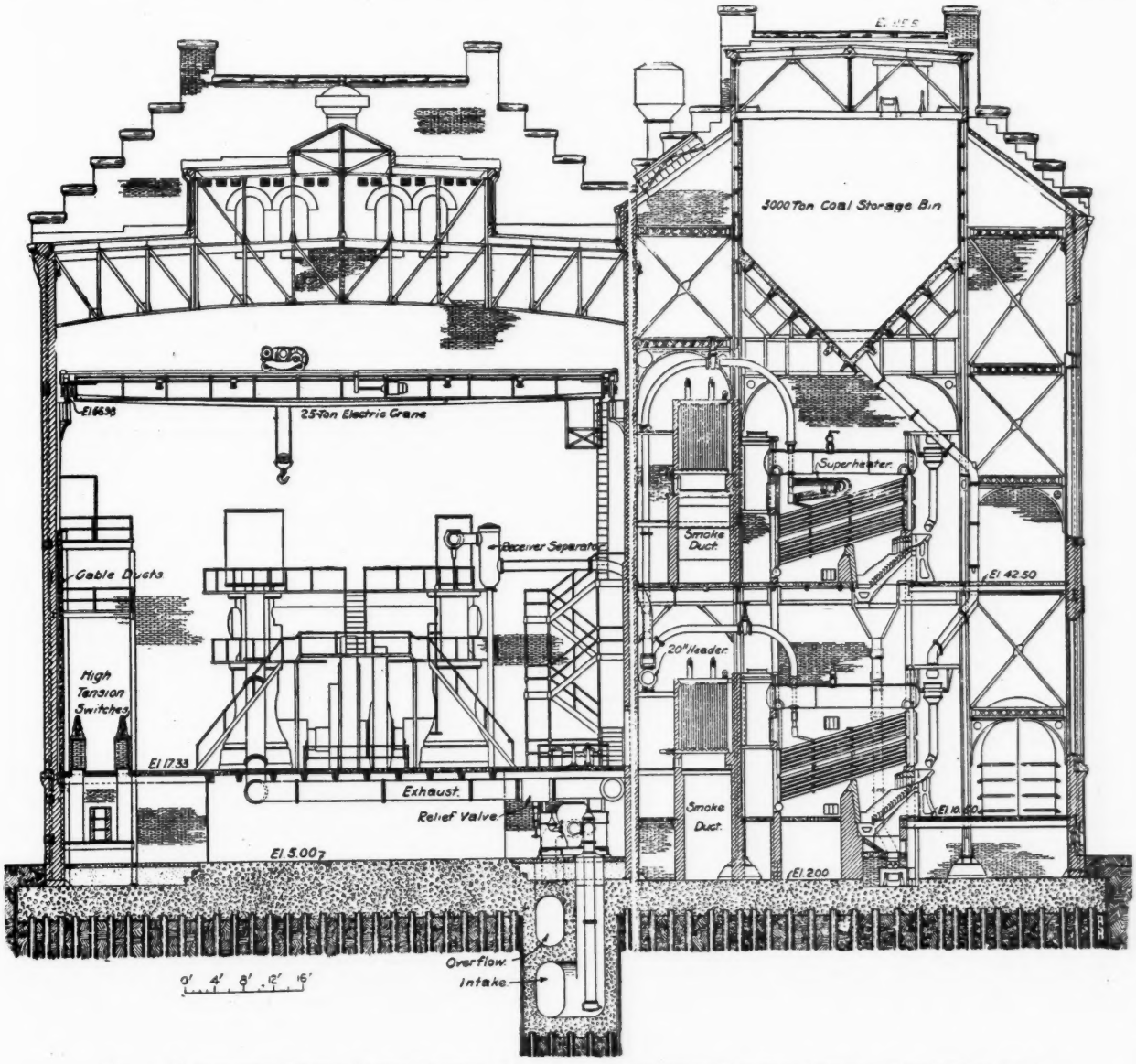


FIG. 1.—MANCHESTER STREET POWER STATION, RHODE ISLAND SUBURBAN RAILWAY COMPANY, PROVIDENCE, R. I.

such matters as the location of track, with special reference to grades and curves, the distribution of copper in the feeder system, the weight and equipment of cars, and train schedules, all of which are important factors in determining upon the power required.

It is often necessary to estimate the size of a new power station before the final survey of the road is completed, or

Having ascertained the power required during the different hours of the day, the plant should be divided into as few units as will enable the engines and generators to be operated at or near their rated capacity, while at the same time a sufficient number should be installed so that in the event of trouble one can be shut down without causing interruption of service. A three-unit station will permit of a fairly uniform distribution of the load in small plants, and in case of accident to one unit, the other two should be able, by overloading, to supply sufficient power until repairs are completed. This number of units is therefore regarded as the minimum which should be installed in any power station.

The type of apparatus to be used, whether alternating or direct current, will not materially affect the design of the station except in so far as the question of the use of reciprocating engines or steam turbines is involved. Up to this time the steam turbine, which is rapidly growing in favor for electric railway work,

has been designed almost exclusively for use in connection with alternating-current generators, and the manufacturers of electrical apparatus have held out scant encouragement that its speed could ever be so modified as to make its use with direct-current generators, particularly the larger sizes, practicable. Reciprocating engines have therefore been regarded as the only type of steam motor available for this class of work. It is probable that this will be the case for some time to come, but it is interesting to note that considerable progress is being made in the development of direct-current turbo-generators. A number of machines of this type as large as 500-kilowatt capacity are in operation, and work is well advanced upon units as large as 2,000 kilowatts. There seems to be good ground for the belief that this problem will be successfully solved, and that in the near future this type of apparatus will be available in sizes as large as are generally required for direct-current work.

Engineers and steam users generally have been prepared for some time to welcome any form of prime mover which could be shown to possess any considerable advantage over the reciprocating engine, as the latter had come to be regarded as having largely fulfilled its possibilities, and no very great improvement in economy was to be looked for. The steam turbine seemed to offer the solution of the question, and while, at the time of its introduction into this country, its superior economy had not been demonstrated, its great simplicity as compared with reciprocating engines, lower first cost, and less floor space occupied, ensured its prompt adoption by a large number of power users, and from the first its progress has been rapid. In a report of the committee for the investigation of the steam turbine made to the National Electric Light Association last June, it was stated that there were in operation at that time two hundred and twenty-four turbines of an aggregate capacity of over 350,000 horse-power, the greater number of which had been installed in the last two years. The writer is informed that the orders for turbines taken by the two largest manufacturers in this country aggregate (July 1, 1905) over 800,000 horse-power.

The remarkable progress made in the manufacture of these machines, and their general adoption by many of the most progressive railways in the country, prove them to be a most formidable competitor of the reciprocating engine, if indeed it does not indicate that they have already established their commercial superiority.

It is to be regretted that most of the data upon the efficiency of steam turbines have been derived from tests covering very short periods of time, usually only a few hours, and that so little data are available of their performance under actual service conditions. To the street railway manager or engineer, power-station records for long periods, showing the coal consumed per kilowatt-hour, or, better still, the efficiency of the plant expressed in percentage of heat energy in the coal converted into electrical energy at the switchboard, are of much greater interest and value than the record of any number of short-time tests for steam consumption only, as it provides him with a much more practical means of making comparisons with the performance of other stations with which he is familiar. The data which have been published illustrating the relative economy in steam consumption of turbines and reciprocating engines rarely ever show comparisons between units operating under identical conditions as to steam pressure, superheat, or vacuum, and therefore does not fairly represent the relative performance of the two types, and, too, the steam consumption of the auxiliaries is also invariably omitted, so that it is impossible to form an intelligent opinion as to the additional cost of the higher vacuum required for the turbine.

Up to this time most of the turbines installed in electric railway power stations are operated in connection with reciprocating engines, and owing to the difficulty of separating the operating charges, it has been practically impossible to obtain reliable information as to their performance under commercial conditions.

One of the plants where turbines are exclusively used is the Quincy power station of the Old Colony Street Railway Company, and through the courtesy of Mr. P. F. Sullivan, president of the company, the writer is permitted to publish some information regarding the performance of this station. This information was kindly furnished by Mr. C. F. Bancroft, superintendent of motive power and machinery.

It should be stated at the outset that this station, which will eventually furnish power for that portion of the Old Colony Street Railway Company's system extending from Quincy on the north to the city of Fall River on the south, is not yet in full operation. Its connection with the latter city, where a large part of the current is to be used, has not yet been made, so that at present it furnishes power for only about one-third of the number of cars which it will eventually drive. Only two of the five turbines in the station are required for this work. One of these machines is run for seventeen hours per day, and two for twenty-four hours per day. When the station is in full operation there should be a more uniform load, and it is expected that the station efficiency will be considerably increased.

The station contains five 2,000-kilowatt, four-stage, vertical turbines, running at 750 revolutions per minute, and connected to 13,200-volt, twenty-five-cycle, alternating-current generators. The steam pressure is 200 pounds. There are ten horizontal water-tube boilers of 750 horse-power each, equipped with internal superheaters, giving to the steam an average of sixty-five degrees superheat. Underfeed stokers are used. There are no economizers. One turbine is supplied with steam-driven auxiliaries; the other four have motor-driven auxiliaries. At present, while only two units are in operation, the feed water is heated to 200 degrees Fahrenheit by the exhaust from the steam auxiliaries. The average daily output is 52,500 kilowatt-hours, giving a load-factor of 54.7 per cent for the two machines. Georges Creek Cumberland coal is used, having an average calorific value of 14,000 British thermal units per pound. The average coal consumption for this station, operating under the conditions outlined above, is 2.94 pounds per kilowatt-hour, showing an efficiency of 8.36 per cent. This record covers a period of six months, ending June 30, 1905.

While this performance does not furnish conclusive evidence of the superiority of the turbine over reciprocating engines in electric railway work, it compares favorably with the results obtained in a large number of the better class of stations using the latter type of prime movers, and gives some force to the opinion that in actual practice there will be found to be very little difference in the coal consumption of steam turbines and reciprocating engine plants operating under similar conditions.

In order to develop the highest efficiency of the steam turbine, it is necessary to operate with a very high vacuum. It is claimed that each inch of vacuum above twenty-six inches will increase the economy from three to four per cent, and condensing apparatus is usually recommended which will produce a vacuum of about twenty-eight inches of mercury, or

two to two and one-half inches higher than that regarded as the most efficient for reciprocating engines. The type of apparatus generally installed consists of a surface condenser with a centrifugal circulating pump, dry vacuum pump, and hot-well pump. In practice no trouble has been experienced in obtaining the high vacuum desired with this type of apparatus, but whether the gain of three or four per cent in coal is sufficient to warrant the additional first cost and cost of operating this rather complicated system, is a question which would seem to be open to discussion. In cases where the cost of feed water is a material factor in the cost of power, or where it contains a large percentage of calcium or magnesium carbonate, or other scale-forming materials, there will be great advantage in using a surface condenser on account of the pure distilled water returned to the boilers, but where these conditions do not exist, it will frequently be found practicable to use some simpler form of condensing apparatus, such for example as the injector or barometric type of jet condensers. These types of condensers offer very great advantages over the surface condenser in the matter of lower first cost, space occupied, greater simplicity, and less cost of maintenance. Up to this time they have not been very generally used, but there seems to be no good reason why they should not work as satisfactorily in connection with steam turbines as with reciprocating engines, and when properly proportioned to the work and installed with tight piping throughout, it is believed that in many cases they will prove to be as satisfactory as the more complicated types.

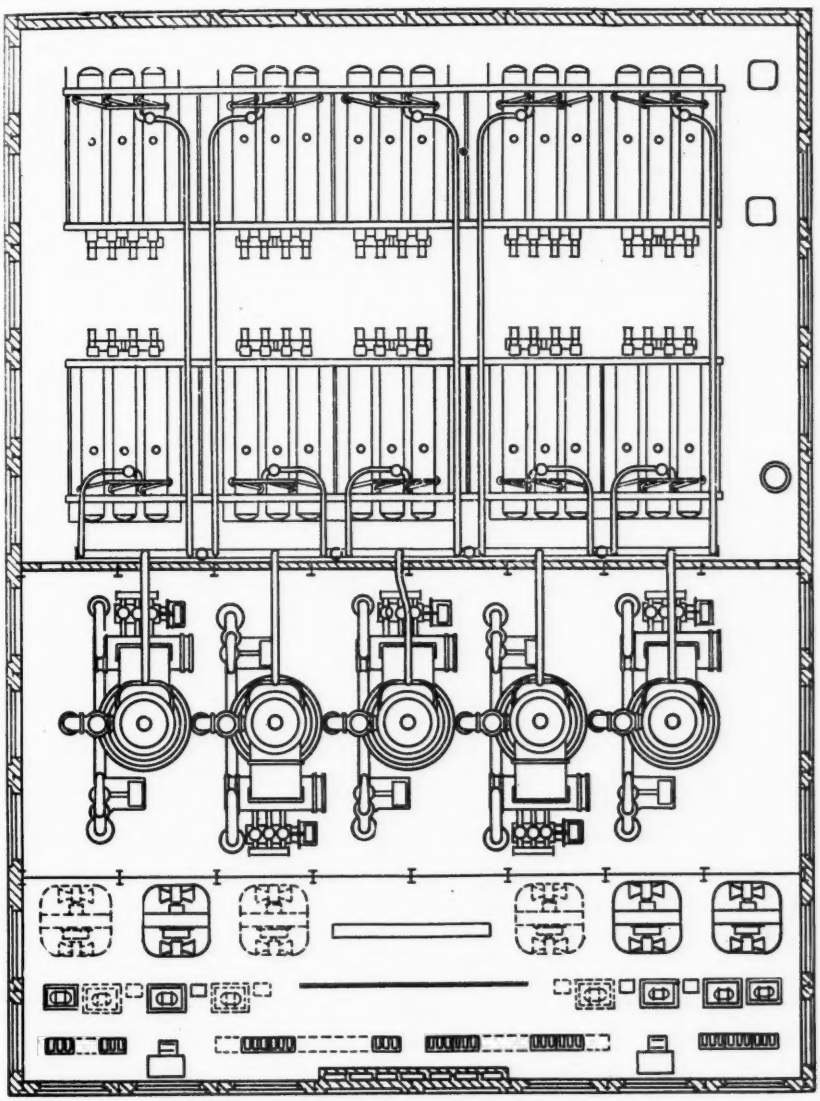


FIG. 2.—QUINCY STATION, OLD COLONY STREET RAILWAY.

A considerable economy in the steam consumption of both reciprocating engines and the steam turbines has been shown to result from the use of superheated steam. In plants equipped with either of these types of prime movers using dry saturated steam, the introduction of superheated steam can generally be depended upon to effect a saving in steam of about one per cent for every eight or ten degrees of superheat. Where the quality of the steam is not so good, and the conditions are such that the condensation in the pipes or cylinders of the engines is excessive, the saving may be much greater than this, sometimes amounting to one per cent for every four or five degrees of superheat.

With reciprocating engines, condensation in the cylinder resulting from the great difference in temperature between the incoming steam and the surfaces of the cylinder which have just been exposed to the temperature of the exhaust steam, has been recognized as one of the greatest sources of loss. Various means have been employed to reduce this loss, such, for example, as the use of steam jackets and reheaters, but these devices add materially to the complication of the engine, and under the most favorable conditions only affect a partial saving. For these reasons they have not been generally adopted in power station work. Superheated steam has been found to be a much simpler and more effective method of accomplishing this result.

Our knowledge of the subject of steam turbines is still so limited that it is impossible to state with any degree of positiveness just where the various losses occur, or to what causes we must attribute the gain in efficiency from the use of superheated steam. Undoubtedly a portion is due to thermodynamic reasons, and it has been suggested that a large portion is also due to the diminution of fluid friction within the turbine. Owing to the very high steam velocities in this type of apparatus, the friction of the steam passing over the surfaces of the buckets must cause a considerable loss, and this is probably very much greater where the steam carries a large percentage of moisture than when it is dry or superheated. It is probable, therefore, that the larger part of the gain due to superheating can be attributed to this cause.

The prevention of the deposit of water on the inside of the turbine casing, also, must effect some saving, although this gain is probably small as compared with that resulting from the diminution in the friction of the steam as it passes over the surfaces of the buckets.

Whatever the causes may be, there can be no doubt that there is a very marked

gain in efficiency in steam turbines from using superheated steam, amounting to about as much per degree of superheat as in the better class of reciprocating engines.

The following table compiled by R. M. Neilson shows the reduction in steam consumption in steam turbines and reciprocating engines due to superheating. These statistics were obtained from a number of tests made in this country and in Europe. The apparent discrepancy in these tests is explained by the statement that there was considerable difference in the quality of the steam in the different cases, and the engines were of different types and of different sizes.

Steam Turbines.			Reciprocating Engines.		
13	6.1	0.47	31	7.86	0.25
50	8.0	0.16	40	8.65	0.22
60	5.4	0.09	50	12.00	0.24
66	12.1	0.18	100	20.55	0.20
70	7.5	0.11	100	13.00	0.09
84	7.7	0.09	216	36.4	0.17
100	14.0	0.14	225	33.7	0.15
140	12.6	0.09	225	33.1	0.15
150	19.0	0.13	440	30.9	0.07
200	23.0	0.115			
260	24.5	0.09			

Unfortunately, superheated steam is now known to be rather expensive to produce, particularly at the higher temperatures, and consequently economy in steam consumption does not necessarily mean economy in the consumption of coal. The chief advantage in its use is obviously in the saving which can be made at the coal pile, and unless this saving can be shown to be sufficient to pay for installing and operating the necessary superheating devices, it will be extremely difficult to convince a careful street railway manager that it will be profitable to use it.

This is a subject upon which there is a vast amount of conflicting information. In a number of instances the use of superheaters has been discontinued either on account of mechanical difficulties or because there was not a sufficient saving in coal to pay for keeping them in service. In other cases no mechanical difficulties have been experienced, and the saving in coal has been all that could be reasonably expected.

It is noteworthy that manufacturers of reciprocating engines and steam turbines, as well as engineers, while still recognizing the value of superheated steam, are disposed to be much more conservative than formerly in recommending its use. At this time, the weight of opinion seems to be in favor of a moderate amount of superheat, say not exceeding 125 degrees. Within this limit there should be a sufficient saving at the coal pile to justify its use, while the temperature is not sufficiently high to cause serious mechanical difficulties with any of the various types of steam apparatus generally used.

For many years after the inauguration of the electric railway industry, power station engineers seemed disposed to devote the greater part of their energies to perfecting the arrangement of engines, generators and switching apparatus, frequently neglecting the more important, though less showy, boilers and their accessories. In recent years they have come to realize that a larger percentage of saving can be made by a proper attention to the design and management of the boiler room than in any other department, as it is here that the greater number of preventable losses in a power station occur.

The designs of the standard types of steam boilers which are now generally used have been perfected to such a degree that efficiencies as high as seventy to seventy-five, and even eighty per cent have been attained under favorable conditions, and there are very few improvements which the power station engineer can suggest which will produce any considerable saving in fuel.

The design of the furnace, as distinguished from the boiler, on the contrary, is one requiring careful thought and study, to make it conform to the conditions required for the perfect combustion of the specific kind of fuel which is to be used. Anthracite coal, owing to its small percentage of volatile matter, can be satisfactorily burned in almost any kind of a furnace, provided the grate area and the draft are sufficient to burn the quantity required to develop the desired capacity, but in the case of semi-bituminous and bituminous coals and lignites, containing a much larger percentage of volatile matter, the furnace should be so designed that this volatile matter, as well as the fixed carbon, will be completely burned in order to develop the full heating value of the fuel.

The following conditions are necessary to ensure the complete combustion of the fuel:

1. A sufficient supply of air.
2. Thorough mixture of air and fuel.
3. A sufficiently high temperature of the air and the combustible gases to ensure their ignition and perfect combustion before they come in contact with the cooling surfaces of the boiler.

The principal source of loss is due to imperfect combustion of the volatile gases, which are distilled very rapidly after fresh coal is placed upon the fire, and not being mixed with air at a temperature sufficient to cause ignition, pass off unconsumed; or the air supply and the temperature being sufficient, they are allowed to come in contact with the comparatively cool surfaces of the boiler, and their temperature reduced below the ignition point before combustion is completed, so that they escape when only partially burned. The mixture, temperature and time are therefore important factors in the combustion of the volatile gases, and it follows that the combustion chamber should be of sufficient size to allow the gases to become thoroughly mixed, and that they should be raised to a sufficiently high temperature and be protected by firebrick walls and arches from the cooler surfaces or the boiler shell or tubes until the combustible portion has been entirely consumed.

As to the proper place to admit the air for the combustion of the volatile gases, D. K. Clarke says:

"It is a matter of perfect indifference as to effect in what part of the furnace or flue it is introduced, provided this all-important condition be attended to, namely, that the mechanical mixture of the air and gas be continuously perfected before the temperature of the carbon of the gas, then in a state of flame, be reduced below that of ignition."

A number of furnaces have been devised in which the air has been admitted at the bridge wall or at the sides or front of the furnace above the grate, and there have been many ingenious plans for heating this air to the proper temperature before its admission to the combustion chamber. Some of these furnaces have been fairly successful as a means of reducing the smoke, but it is doubtful if the admission of air above the grate has ever materially increased the efficiency of the furnace. By far the most common practice is to admit all the air through the grate, that required for the combustion of the volatile gases being heated to the proper temperature by passing it through the bed of incandescent fuel.

In many of the larger railway power stations the flue gases are regularly analyzed to ascertain the amount and distribution of the losses due to incomplete combustion and the amount of excess air admitted to the furnace, which information is necessary to enable those in charge to operate the boilers in the most efficient manner. The only way in which the waste which takes place in the furnace can be detected is by such an analysis, and its importance as a means of reducing boiler-room losses

is so great that it merits a much more general use.

In the combustion of coal the object in view is to produce the highest possible percentage of carbon dioxide per unit of fuel burned. The higher the percentage of carbon dioxide, the more perfect will be the combustion of the fuel and the higher the furnace temperature, as is shown from the fact that a pound of carbon burned to carbon dioxide will produce 14,600 British thermal units, while only 4,450 British thermal units will be produced when, on account of an insufficient supply of air, carbon monoxide is formed. The gas analysis will show the percentage of carbon dioxide, carbon monoxide and oxygen. This information will enable the chemist to determine the total heat in the escaping gases, the amount of unconsumed gas, and the losses due to an excess air supply, and will also indicate the cause of these losses and suggest the proper remedy.

A low temperature of escaping gases is frequently regarded as an indication of efficient furnace conditions, but it is quite as likely to be caused by an excess of cold air, due to too strong a draft, uneven fires, or leakages through the boiler settings. The true condition of affairs can only be revealed by means of an analysis of the flue gases. Anything which will increase our knowledge of the conditions which take place within the boiler setting, and will permit of a more intelligent use of fuel, should be encouraged and for that reason the practice of analyzing the flue gases is recommended in all railway power stations where the cost of fuel is an important factor in the cost of power. It is always preferable to have this analysis made by an experienced chemist, but in small stations where the saving to be made is not sufficient to warrant the employment of such a man, it is said to be possible to obtain fairly satisfactory results from the use of one of a number of automatic or semi-automatic devices which are now manufactured for the purpose.

Mechanical stokers are now almost universally employed in electric railway power stations, on account of the increased efficiency over hand-fired furnaces and the reduced cost of operation. In a properly constructed furnace of moderate size, equipped with flat grates, an intelligent and careful fireman will produce results equally as satisfactory as any which have been obtained with any of the various types of mechanical stokers; but the trouble is that such firemen are not plentiful, and it is extremely difficult to secure men who will produce uniformly good results for long periods of time. For this reason the average fuel economy in a railway power station will generally be found to be somewhat better where the firemen are assisted by some form of mechanical stoking device.

It should be borne in mind, also, that

FIG. 3.—BOILER ROOM, MANCHESTER STREET STATION.

in order to economize in space and the initial cost of the plant, the size of the boilers and the rate of combustion have steadily increased in the last few years until they have now reached a point where it is doubtful if the larger sizes can be properly stoked by hand, even by the most competent firemen.

The use of mechanical stokers is necessary in connection with these large sizes of boilers, in order to drive them up to the capacity required in electric railway plants.

There can be no doubt that mechanical stokers accomplish a considerable saving in boiler-house labor. A reasonable day's work for a fireman is the shoveling of sufficient coal for about 500 horse-power of boilers, which in a railway power station will amount to from six to eight tons every twelve hours. Where automatic stokers are used, and coal is delivered to the hoppers by gravity, one man should be able to take care of about 2,000 horse-power of boilers, which is equivalent to a reduction in labor of seventy-five per cent. The cost of maintenance of automatic stokers is somewhat greater than that of flat grates, and additional labor is required for repairs as well as for tending the coal-handling machinery usually installed in connection with them, so that the net saving in labor will be somewhat less than that indicated above. There is a point, of course, at which this saving is not sufficient to pay for the additional fixed charges and repairs upon the mechanical stoking devices. This point is reached in a boiler plant of about 2,000 horse-power capacity. In a plant of greater capacity than this, automatic stokers can generally be shown to return a sufficient net saving to warrant their use, while in smaller plants it will frequently be found to be profitable to use them on account of the cheaper grades of fuel which can be burned and the greater capacity which can be got out of the boilers.

Perhaps the most difficult problem to be solved in connection with the power station is to secure proper attention to details of operation by the subordinate employés. In the most carefully designed plant, equipped with the most efficient types of machinery, the results which the railway manager and designing engineer may reasonably expect in the way of economy will not be achieved unless the utmost care and vigilance are exercised by the operating forces. The successful operation of the station will depend largely upon the way in which the forces are organized, and discipline maintained. Just how the station organization should be made up is a question which can only be decided for each plant after a careful study of all the conditions; but it is safe to say that however the various departments may be organized, there should be one man in supreme authority, possessing considerable executive ability as well as a thorough practical knowledge of steam and electricity, whose decision should prevail in the event of disagreement among the heads of departments or at times of emergency. As he is the one who will be held responsible for the successful performance of the station, it is essential that whatever regulations there may be regarding the employment of his subordinates, he should have full authority to dismiss any who prove to be incapable or are not disposed to be attentive to their duties. It will be practically impossible to maintain proper discipline if among the employés there are those who feel a certain sense of security in their position through the influence of some one higher in authority than the man in charge of the station.

The work of the greater number of station employés is necessarily of a routine character. It is nevertheless important that they should be thoroughly instructed in their duties and required to perform them with the utmost regularity. For example, an oiler employed upon an engine should receive instructions as to the minutest detail of the work that he is required to do. He should not only be required to see that his lubricators are full and working properly, and that every part is receiving a sufficient quantity of oil or grease, but he should feel of every bearing and should observe every part of the engine as he passes around it to assure himself that it is in proper operative condition. He should be required to perform these duties at regular intervals of every twenty or thirty minutes, and his attention should be called to the time for him to commence his rounds by a bell or whistle, or some other form of signal. If there is any part requiring attention, it should be immediately reported to the engineer in charge, who will thus be given an opportunity to apply the proper remedy before the trouble has developed to such an extent as to cause damage or interruption to the service. If the oiler attends to his duties properly, there will be no trouble from hot bearings, from keys, pins or bolts working loose, or from any changes in the adjustment of any part which it is possible to discover when the engine is running.

The work of all other station employés should be systematized along the same lines. The watch engineers should report in writing to the engineer in charge details of the apparatus which in their judgment require attention, and as soon as the machinery can be shut down, these parts should be carefully inspected, and if they show signs of weakness or excessive wear, immediately renewed or repaired. An examination of the enclosed parts of the engines and other working machinery should also be made at frequent intervals and before there are any outside evidences of trouble.

It is necessary that all subordinate employés should be under constant supervision to ensure a proper attention to their duties, but this is especially true of the fire-room forces. Firemen are not generally disposed to take as much interest in their work as employés in other departments. They seem to be content to remain as firemen, and rarely endeavor by excelling in their work, to advance their positions. It is in this department that the greatest losses will occur through indifference on the part of the attendants, and it is therefore of the utmost importance that their work should be carefully done. The only way to accomplish this known to the writer is to place this department in the immediate charge of an intelligent and capable man, whose salary and the knowledge that the permanency of his position will depend upon the results produced, will be sufficient for him to keep constantly in touch with those immediately under him and insist upon their performing their duties properly.

In most power stations records are kept of the coal and water consumption, the temperature of the feed water and flue gases, and the station output, by which the performance of the station from month to month can be compared. These records furnish a check upon the condition of the station, the manner in which it is operated, and assure its being maintained in a high state of efficiency. The writer has found that in addition to these records, an occasional test of the entire plant under actual operating conditions for periods of say twenty-four to forty-four hours, are also of great value as a means of furnishing definite knowledge as to just what the station is capable of doing. Such tests also have a certain educational influence upon the employés, particularly the firemen, as they illustrate to them what can be done when all engaged on the work are exerting their best efforts

to secure the most efficient results possible.

At the Rhode Island Suburban Railway Company's Manchester street station all of the usual records are kept, and the quantities and costs carefully determined for each month, and tests of the entire plant are also made as suggested above. The writer believes that these tests have a sufficient influence upon the regular performance of the station to justify a brief description of it, and the publication of the results in the matter of coal consumption from the time it was placed in commission, showing the gradual improvement in efficiency.

This station was originally designed for the Rhode Island Suburban Railway Company to furnish power for its lines operating in the vicinity of Providence. It was intended to use horizontal units, and two 1,500-kilowatt alternating-current units and one 1,600-kilowatt direct-current unit were purchased. Before work on the building had progressed beyond the foundations, however, it was decided to increase the capacity of the station by installing two additional direct-current units of 2,500 kilowatts each. This required a number of changes in the structure, and necessitated double-decking the boiler room in order to provide the necessary additional boiler capacity. The present equipment of the station consists of fourteen horizontal water-tube boilers of 520 horse each, eight on the lower floor and six on the upper floor. The boilers on the lower floor have no superheaters, but those on the upper floor are equipped with internal superheaters, each made up of eighty-four two-inch tubes suspended below the boiler drums. The superheaters on two of the boilers were designed for only 125 degrees of superheat, and contain 615.3 square feet of effective heating surface each. Those on the other four boilers were designed for 150 degrees of superheat, and contain 855.5 square feet of heating surface. Each boiler has 5,159 square feet of heating surface.

Roney mechanical stokers are used, each containing 112 square feet of effective grate surface. A 280-tube Green fuel economizer is installed directly back of each battery of boilers, the flue being so arranged that the hot gases may be passed through the economizers or directly to the main flue as desired. The heating surface per square foot of grate is for boilers forty-six square feet, for economizers fifteen square feet, or a total of sixty-one square feet. Natural draft is used. The boiler pressure is 145 pounds. There are three horizontal compound engines with cylinders 32 and 64 by 54 inches, operating at ninety-four revolutions per minute, and two vertical compound engines with cylinders 42 and 86 by 60, operating at seventy-five revolutions per minute. All of the engine auxiliaries are steam driven. Jet condensers are used, the air pumps being of the twin vertical type. The average vacuum in the engine cylinders is

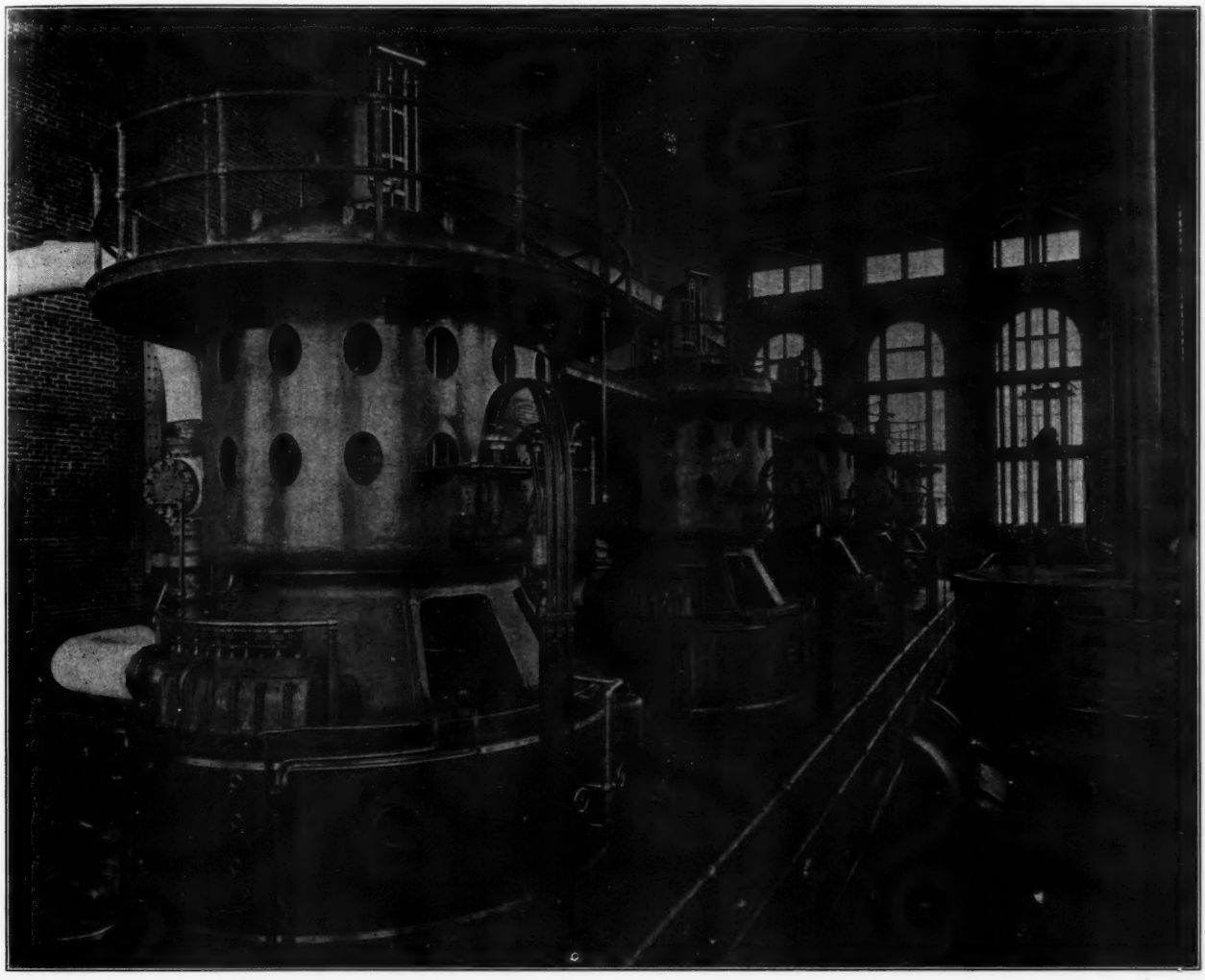


FIG. 4.—TURBINE ROOM, QUINCY STATION

twenty-five and one-half inches of mercury. There are two alternating-current generators each of 1,500-kilowatt capacity, delivering current to the line at 11,000 volts, and one 1,600-kilowatt and two 2,500-kilowatt direct-current generators delivering current at 600 volts. The normal capacity of the station, therefore, is 9,600 kilowatts. Direct current is furnished for twenty-four hours per day, and alternating current from 5 A. M. to 1 A. M. There are no feed-water heaters between the engine cylinders and the condensers, but the exhaust steam from the auxiliaries is carried to two heaters located in the basement on the suction side of the feed pumps. These heaters are made up of horizontal U-tubes arranged in series, the steam entering at the top and discharging at the bottom, while the water enters at the bottom and discharges at the top. Each heater contains 750 square feet of heating surface, and in practice all of the steam from the auxiliaries is condensed and is discharged at a temperature only about thirty-five degrees higher than the incoming cold water. The average daily output of the station is 102,500 kilowatt-hours.

The following is the performance of the station under actual service conditions from the time it was started in regular service, February, 1904. It should be borne in mind that the first battery of boilers with superheaters was installed eleven months after the station was started, and four months thereafter two additional batteries of boilers with superheaters were commissioned, and the performance of the station is therefore given for the periods covered by these different conditions.

Eleven months, saturated steam, 2.87 pounds of coal per kilowatt-hour.

Four months, slightly superheated steam (no record of temperature kept), 2.37 pounds per kilowatt-hour.

Three months, superheated steam, average temperature at engine throttle 465 degrees (102 degrees superheat), 2.46 pounds of coal per kilowatt-hour.

The apparent reduction in coal consumption per kilowatt-hour with steam superheated about 100 degrees is 14.3 per cent, but all of this saving can not be attributed to this cause. A large part of it is undoubtedly due to the increased efficiency of the fire-room attendants. Probably not over eight to ten per cent should be credited to the use of superheated steam.

The Annual Report of the Western Union Telegraph Company.

The annual report of the president of the Western Union Telegraph Company, Incorporated, to the stockholders was made at the meeting, October 11, 1905, by Colonel Robert C. Clowry.

The report states that there was a large increase in revenue from message business, but that the loss resulting from the discontinuance of race reports shortly before the beginning of the fiscal year made a decrease of $215,755.40 in the total earnings. Owing to the conditions under which the race service has been handled, a proportionate decrease could not be made in the expenses, which show an increase of $483,654.86, of which amount about $300,000 represents the handling of increased message business. The balance was in the cost of reconstructing lines, which was the largest in the company's history, and was caused by work designed to raise the standard of the lines, increasing the number of poles per mile on the main routes, substituting copper for iron wire, and sundry other details of importance.

The net growth of the plant was 874 miles in poles and cable, 29,152 miles in wire, and 356 new offices. There was an increase in copper during the year of 16,466 miles, making 306,736 miles of copper wire out of a total wire mileage of 1,184,557 miles. The cost of new construction was $1,177,500.24, which was $1,288,279.45 less than last year. The substitution of dynamos and storage batteries for the old-style chemical batteries was authorized at thirteen important centres.

Contracts covering 3,474 miles of railroad were closed during the year.

The balance sheet for June 30, 1905, is as follows:

ASSETS.

Telegraph lines, stocks owned of leased telegraph companies that are merged in Western Union company's system, franchises, patents, etc.	$115,717,186.08
Stocks and bonds of leased telegraph companies received in exchange for collateral trust bonds.	8,504,000.00
Stocks of not leased telegraph companies, and other securities	13,750,749 89
Real estate	4,957 432.12
Supplies and material in supply departments	465,907 06
Sundry accounts receivable, etc.	2,829,576.40
Cash in treasury and in hands of agents (since remitted to treasury)	4,011,726.47
	$150,236,577.52

LIABILITIES.

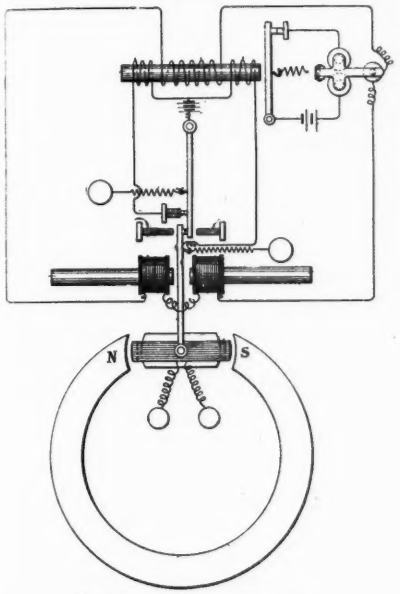
Capital stock	$97,370,000.00
Funded debt	28,504,000 00
Gold and Stock Telegraph Company for stocks of other companies held through lease of that company until 1981	1,946.592.00
Sundry accounts payable, etc. (including dividend July 15, 1905)	4,218,882.33
Surplus of income prior to October 1, 1881, appr priated for construction and acquisition of telegraph lines and property (in excess of the $15,526,590 capital stock distributed in 1881 on account of such appropriations of income during the 15 years preceding)	1,598,184.08
Surplus of income subsequent to October 1, 1881 ($15,974.209.25), plus the proportion of surplus of income prior to October 1, 1881 ($629,759.91), that was not appropriated as above	16,603,969.16
	$150,236,577.52

The Special Electrical Conductivity of the Air at Sea.

During a recent trip from Liverpool to Boston, Mr. J. E. Burbank was afforded an opportunity to make some observations of the specific electrical conductivity of the air. The instrument employed was a new one devised recently by Dr. H. Gerdien. It consists of a tube about twenty centimetres in diameter, in the centre of the lower side of which is a side tube connecting with the electroscope. The inner electrode consists of a thin brass tube with hemispherical ends 1.4 centimetres in diameter, placed in the axis of the tube and connected with the leaf-holder. In the rear part of the tube is a fan driven by hand by means of a worm-gear. This fan drives a current of air through the tube, and observations have shown what theory indicates, that the velocity of the air currents through the tube may vary within wide limits without changing the observed values of the conductivity. During the voyage, however, it was found convenient not to use the fan, but to allow the wind to blow through the tube. This method was found to be just as reliable as when using the fan. This instrument has the advantage of reducing greatly the time required to make observations, as satisfactory readings can be obtained in from three to five minutes. The insulation of the instrument is excellent, as was shown several times during a dense fog, when the inner electrode became so damp that it was necessary to remove it and wipe it every few minutes. Leakage tests made after the observations, however, showed no appreciable fall of potential. The results show conductivities varying from one-third to two and one-half times those of the air at Göttingen and at Cheltenham, Md. On one occasion a heavy fog prevailed, and during this time the conductivity fell to about one-tenth that of the Göttingen air. The fog appears to affect both kinds of ions to nearly the same extent. Other fogs showed the same effect of decreasing the conductivity, but none to the same extent just mentioned. During these fogs the air in the cabins also showed low conductivity.—*Terrestrial Magnetism and Atmospheric Electricity (Baltimore), September.*

Electrical Patents.

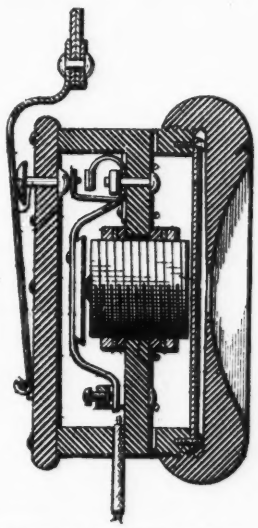
Stephen Dudley Field, Stockbridge, Mass., is the inventor of an improvement in quadruplex telegraphy (800,844, October 3, 1905). In the operation of that class of duplex telegraph systems which when duplexed become capable of transmitting four simultaneous communications upon the same circuit and which depend upon one transmission by polarity and the other by strength of circuit, a defect is observed when attempts are made to introduce the apparatus on circuits



QUADRUPLEX TELEGRAPHY.

having great impedance or great static capacity, such as long buried conductors or what are known as "composite" circuits in telephone service. The prolonged "variable" period of such circuits causes a sluggish action of the receiving apparatus in such a manner that the repeated signals in the local circuit become blurred. Attempts have been made to bridge over this variable period by the introduction of induction coils in the line circuit, but such introduction, by bringing in magnetic impedance in the line circuit, increases the static capacity thereof to an extent which is rather more than an offset to the benefits conferred by the devices mentioned. In the present invention, a distinctly opposite course is pursued. Instead of increasing the line impedance, the inventor diminishes it as much as possible and instead of holding the relay quiescent at the moment of current change, he locally augments its action as much as possible. In carrying out the invention, the apparatus is so arranged that a break once started in the local or receiving circuit is caused to locally react on the relay armature in such a manner as to force it to make its full excursion no matter how slowly the line current may increase nor how soon a reversal of polarity takes place.

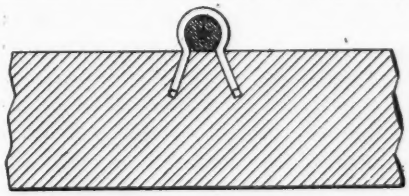
Herman G. Pape, of New York, N. Y., has devised and patented a combined telephone receiver and aural massage instru-



COMBINATION TELEPHONE RECEIVER.

ment, the object being to produce in the smallest possible compass an instrument which may be used either as an ear-piece for audiphone sets or as a massage device for the treatment of a patient having impaired hearing (800,676, October 3, 1905). In the embodiment of the invention, a casing is provided having an apertured wall dividing the casing into front and rear compartments. An electromagnet is mounted in this apertured wall. An armature is located in the rear compartment of the casing and is opposed to one end of the magnet. A diaphragm is located in the front compartment and is opposed to the opposite end of the magnet. An interrupter is operated by the armature, this interrupter being located in the magnet circuit. Means are provided for closing a circuit through the magnet and interrupter.

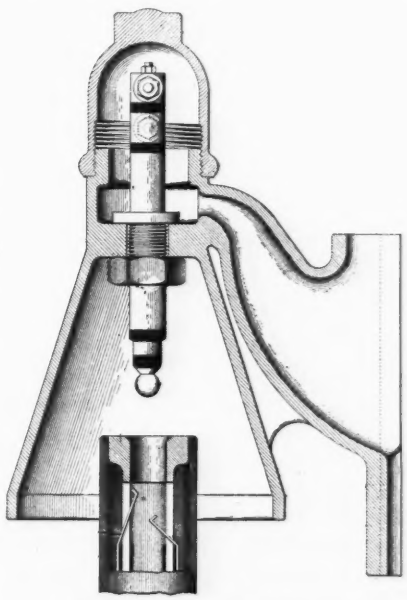
Carroll Potter, of Philadelphia, Pa., has secured a patent on means for securing electric conductors (800,170, September



MEANS FOR SECURING ELECTRIC CONDUCTORS.

26, 1905). The object of the invention is to provide means for positively securing electric wires or conductors to place on a switchboard or the like and means which will subserve this purpose without damage to the insulation and conductor and without disfiguring or mutilating the switchboard. The invention consists of the combination with the refractory body of a switchboard having diverging sockets drilled therein, of an electric conductor, and a keeper having a part to clamp the conductor and having spring-arms which penetrate the sockets and bind against the walls thereof.

The Western Electric Company, Chicago, Ill., controls a patent granted to Frank R. McBerty, of Evanston, Ill., on a connection switch member (800,755, October 3, 1905). The invention relates more particularly to switch members which may be employed as the connection terminals of telephone lines, to be mounted upon poles at intervals along such lines, at which terminals portable telephone sets may be temporarily united with the lines. Such telephone lines are employed, for example, in connection with electric railways in order that trouble,



CONNECTION SWITCH MEMBER.

accidents and the like may be avoided to the company. The object of the present invention is to provide a mounting for the connection terminals of the telephone line, so that they shall be easily accessible for use, repair and adjustment, and at the same time protected from injury. In carrying out the invention, a metallic hood is employed, having a cap for the top thereof. A metal cross-piece is located within the hood, through which cross-piece a plug passes. A flange is located upon the threaded sleeve of this plug and is adapted to abut against the rear of the cross-piece. A nut is adapted to be screwed upon the sleeve and against the front of the cross-piece to bind the plug in position. A support for the hood has a passage leading therethrough and opening into the hood behind the cross-piece, through which conducting-wires may be led to the plug.

Reviews of Current Engineering and Scientific Literature.

Trees as Receivers for Wireless Telegraphy.

The recent statement that trees might be utilized as the antennæ for wireless telegraph systems recalled to Herr K. E. F. Schmidt certain observations which he made some little time ago on trees which had been struck by lightning. These trees showed the track of the discharge in loosening of the bark and the blowing out of the disintegrated wood through grooves. These grooves seemed to follow the grain of the wood from the branch where the discharge first touched the tree down to the roots, and suggested the idea that the sap of a tree, coming from the roots, follows definite paths through the young wood to definite branches. To test this idea, staining fluids were injected into certain roots of oaks and maples. After some time the bark of the trees was opened, and it was found that the stain had been carried up the trunk along narrow paths. This result seemed to be in accordance with the ideas expressed above—that is to say, sap, in rising, does not spread out indiscriminately, but follows narrow lines. This being true, it follows that an electric current entering a tree at a branch and passing to the ground through the roots will also follow more or less narrow paths; therefore, to utilize a tree in wireless telegraphy to the best advantage, the electrical connection must be made at that part of the trunk corresponding to the highest branch which it is intended shall act as the antenna. This may be found experimentally by tapping at various points around the trunk, but generally the contour of the trunk and the markings on the bark will indicate pretty accurately where the attachment should be made.—*Translated and abstracted from Elektrotechnische Zeitschrift (Berlin), September 7.*

A Demonstration of the Parabolic Path of a Cathode Ray in an Electrostatic Field.

Theory indicates that a cathode ray projected through a uniform electrostatic field should follow a parabolic path. This is usually demonstrated by means of long tubes, and the rays generally employed are so weak that phosphorescing screens are needed to make them visible. M. A. Wehnelt here shows a pretty method of illustrating this phenomenon. He has shown previously that a cathode ray, starting from an incandescent electrode coated with metallic oxides, is sufficiently intense to be visible throughout its path. He constructs an instrument as follows: the tube is a spherical bulb having inserted through one side the electrode for throwing out the cathode ray. This is a strip of platinum foil heated to incandescence by means of a storage battery. At opposite sides, with respect to this electrode, are a small spherical electrode and a circular plate electrode which may be charged electrostatically to a high potential. Upon bringing the platinum foil to incandescence by means of a heavy current, a cathode ray is thrown off horizontally and impinges upon the plate electrode. If then, the latter be charged, the ray no longer remains horizontal, but is deflected upward—since the plate electrode itself is inclined at an angle—and before reaching the plate is turned back on its path at an angle of about eighty-five degrees. The path followed is thus very closely a parabola. It is not a true parabola, since the electrostatic field is not uniform. A photograph of the apparatus is shown, indicating clearly the path taken by the ray. A closer approximation to a parabola could be obtained by the use of two plate electrodes, placed so as to give a uniform field; but such an arrangement complicates the instrument considerably.—*Translated and abstracted from Physikalische Zeitschrift (Leipsic), October 1.*

Uniform Equipment in Electric Power Plants.

A plea is made here by Mr. H. S. Knowlton for uniformity in the equipment of electric power plants. For some years past far-sighted engineers have been working toward that unification of equipment in the power-house which requires the generation of but two kinds of current within the station walls; direct current for the field excitation, and high-tension alternating current for the output of the plant. The author believes that the day has come when this can be done, since we have to-day satisfactory alternating-current enclosed arc lamps, induction motors, and even an alternating-current railway motor. There will still be important installations for direct-current production, since direct currents are essential for many electrochemical processes, and since, also, 2,000-kilowatt, direct-current generators, direct-driven by turbines, can now be purchased. The advantages of uniformity of equipment are: the great simplification of the plant, the reduction in the number of spare parts required, and an interchangeability of parts. It is said that the introduction of the steam turbine in place of the reciprocating engine makes it possible, by means of three equal units only, to operate a plant at a high efficiency at any load from twenty per cent to full rated output. Another development which aids in unification is the remote control of oil switches, which greatly reduces the complexity of the wiring in the station. The author believes that in the future consolidations will take place and equipments will be more uniform, which will reduce expenses. There is little danger of going too far in this direction in new plants; on the other hand, it is high time for the older installations to look about and see what can be done toward eliminating superfluous apparatus.—*Abstracted from Cassier's Magazine (New York), October.*

The Ultimate Disintegration Products of the Radioactive Elements.

The prediction made by Rutherford and Soddy that during radioactive reactions the other elements are formed, led to a research into this matter and an apparent confirmation of the prediction by Ramsay and Soddy. This work has suggested to Mr. Bertram B. Boltwood an examination of radioactive minerals with a view to determining what indications there are of the formation of other elements by the breaking up of the heavier elements. This has been done with the following results: lead has been detected in every sample of primary mineral containing over two per cent of uranium. Thorium has been detected consistently in uranium minerals, and although Strutt believes that uranium is a disintegration of thorium, the author holds rather to the reverse opinion. Bismuth is also found as a constituent of the more highly radioactive minerals; hence it is a probable product of disintegration. Barium is another element which persistently appears as a minor constituent of uranium minerals. But very small amounts of this are found, so that if it be a disintegration product, it is produced slowly. Hydrogen is found in the greater number, if not all, of the radioactive minerals. It would seem possible that the difference in the ionizing power, of the power of

penetration, etc., shown by the α particles may be due to a difference in the mass of the projected particle, and that the occurrence of notable quantities of water in the primary radioactive minerals, which is otherwise most difficult to explain, may be considered as indicating that hydrogen is one of the disintegration products, originating as an α-ray particle from one of the numerous radioactive substances. The work of Ramsay and Travers indicates that argon is another of the disintegration products of radioactive substances. It is possible that some of the rayless changes observed by Rutherford may be accompanied by the expulsion of α particles, consisting of argon, which, owing to their relatively high mass, are projected at too low velocities to cause ionization. The author then gives analyses of a number of radioactive minerals, and asks if it can be demonstrated that the elements mentioned above, or any of them, actually result in the disintegration of uranium, whether the quantities of these chemical elements already existing have been produced wholly in the same manner. Discussion of this question seems premature at this time, but the time may not be far off when it will deserve serious consideration.—*Abstracted from the American Journal of Science (New Haven), October.*

The Quadrant Electrometer as Used for Measuring Current.

The extensive use of the quadrant electrometer in radioactivity work has induced Mr. O. M. Stewart to make a mathematical investigation of the properties of this instrument. Since it is used generally only for measuring small currents through some gas, the discussion is restricted to this particular use. In measuring current, the needle of the electrometer is generally charged to a relatively high potential, one pair of quadrants is grounded, and the other pair is connected to the conductor into which the current from the gas passes. The observer then determines the rate of motion of the electrometer needle, and this is taken to be proportional to the current. This use of the instrument involves two assumptions: first, the capacity is constant; second, that the equation representing a stable deflection of the needle also holds true when the latter is in motion. Neither of these assumptions is true, but Thomson has shown that when the needle moves, there is a certain effective capacity which, for a given needle, is constant, and he has made such use of the equation which represents a deflection of the needle as to give correct results when the velocity of the needle has become constant. In other words, the effective capacity is constant when the needle is moving without acceleration. The author then discusses the analytical relations, first assuming a constant capacity and then a variable capacity, which shows that there is an advantage in damping the instrument; but there is also a certain critical value of the damping which, if exceeded, causes the velocity to approach its final value more slowly. To adjust the damping, the following general rule is given: the velocity approaches its final value at the same rate and in the same manner that the deflected needle, when released by grounding the quadrants, returns to its zero. This enables the proper amount of damping to be secured. The author, from his examination of the instrument, suggests several methods of using it, in which it is not necessary to wait until the needle has attained a uniform velocity. One method is to observe the deflection reached in a given time after the quadrants are insulated. If the same time interval be used in all the observations, the deflection in each case will be proportional to the current. This method is of great advantage where the readings must be taken quickly. It has the disadvantage that with sensitive electrometers the break of the earth connection often imparts a slight initial charge to the quadrant. When used in this way, the deflection of the instrument after a given time is not proportional to the sensibility of the instrument. The method has the disadvantage that the absolute value of the current can not readily be computed. The instrument might be used for determining the current by observing the time required for the needle to move a certain amount, but this does not give correct results unless the needle be moving with a uniform velocity.—*Abstracted from the Physical Review (Lancaster), October.*

Battery Resistance by Mance's Method.

Mance's method of measuring battery resistance is one of the oldest devised, yet Professor Arthur W. Smith believes that it is one of the least understood. As usually discussed in textbooks, this method is described as being a modification of Wheatstone's bridge, in which the cell to be measured takes the place of the unknown arm, and the usual battery is replaced by a single key. When the opening or closing of this key produces no change in the steady deflection of the galvanometer, it is explained that "the usual relation of Wheatstone's bridge is satisfied." This statement is an error, as is shown by Professor Smith, but Maxwell, even, slipped into this error, and many textbooks since then have followed. Even in the later editions of Maxwell, an attempt to correct the explanation is made, but it has no meaning. That the Wheatstone bridge relation does not hold is readily seen by constructing the diagram in the usual form. When the key is closed, two sections of the circuit are short-circuited, and the current through the battery must therefore be changed. In fact, the Wheatstone bridge is essentially a divided circuit, while Mance's method as modified by Lodge, who introduces a condenser into the battery circuit, is a series circuit. Lodge's modification has, besides, the advantage of making the method easier. The mathematical explanation of the system is simple, and is as follows: let e be the difference of potential at the galvanometer terminals, I the current in the circuit, and X, R, P and Q the resistances of the battery and the sections of the circuit in the order given; then

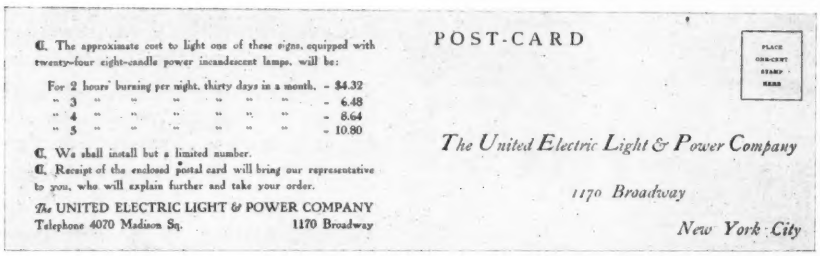
$$e = I\,(P + R) = \frac{E\,(R + P)}{R + P + Q + X}.$$

Let e' equal the value of the potential at the galvanometer terminals after closing the key circuits; then $e' = RI' = \frac{ER}{R + X}$. If the galvanometer shows no additional deflection, these two equations may be equated, and upon reduction it is found that $X = \frac{RQ}{P}$. This result appears in the same form as the relations deduced for the Wheatstone bridge, but this is merely a superficial analogy, and beyond this there is nothing in common between the two methods. The Wheatstone bridge method consists in dividing two parallel circuits in the same ratio. Mance's method consists in subtracting from the two portions of a single circuit such resistances that the two portions shall still maintain the same ratio to each other. Professor Smith then shows an application of this method to a storage battery. The probable error is found to be one part in 2,600. The measurements give resistances of the battery which vary, the smaller values being obtained with the larger currents. Mr. Henry Mance, who originated this method, was superintendent of the Mekran Coast & Persian Gulf telegraph department, and he devised it to assist him in locating faults. He then showed that it could be used for measuring battery resistance, but he did not assume that there was any analogy to the Wheatstone bridge method.—*Abstracted from Science (New York), October 6.*

Methods of Getting New Business.

A department devoted to the commercial development of Central Stations. Managers are invited to contribute suggestions for methods of increasing the demand for electric service.

The Edison Electric Illuminating Company, Brooklyn, N. Y., is very active in placing before prospective patrons the possibilities of electric sign illumination. A neat card which was pretty widely distributed, and which gained considerable favor with a number of merchants, is reproduced herewith. This was printed on a deep-tan card in black ink, and gives the customer a good idea of not only the appearance of the sign, but the cost of illumination. The argument is convincing, and in many cases has started an enquiry which has resulted in permanent business.


¶ The approximate cost to light one of these signs, equipped with twenty-four eight-candle power incandescent lamps, will be:

For 2 hours' burning per night, thirty days in a month, - $4.32
" 3 " " " " " " " - 6.48
" 4 " " " " " " " - 8.64
" 5 " " " " " " " - 10.80

¶ We shall install but a limited number.
¶ Receipt of the enclosed postal card will bring our representative to you, who will explain further and take your order.

The UNITED ELECTRIC LIGHT & POWER COMPANY
Telephone 4070 Madison Sq. 1170 Broadway

POST-CARD

PLACE ONE-CENT STAMP HERE

The United Electric Light & Power Company

1170 Broadway

New York City

POST CARD FROM THE UNITED ELECTRIC LIGHT AND POWER COMPANY.

The United Electric Light & Power Company
General Offices: 1170 Broadway, New York City

Please have your representative call at

on

at ____ a. m. ____ p. m.

Truly yours

ELECTRIC SIGNS!!

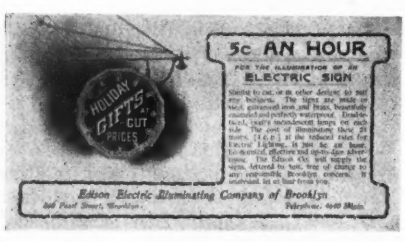
THIS COMPANY is prepared to furnish on loan *and* install in front of your premises an electric sign, painted in any manner you may desire, *and* without cost to you for other than the current consumed, *and* measured by your present meter.

¶ You simply guarantee that you will use to the extent of, at least, $3.00 per month, *and* the sign, painted to meet the requirements of your business, is hung ready to BLAZE OUT YOUR NAME OR BUSINESS through the night, *and* strike the eye of the passing public through the daytime as well.

(over)

POST CARD FROM THE UNITED ELECTRIC LIGHT AND POWER COMPANY.

The United Electric Light and Power Company, New York city, distributes a return postal-card, a reproduction of which is given herewith. The company is prepared to furnish on loan and install in the front of the premises an electric sign, painted in any manner, and without cost to the patron other than the charge for the current consumed, measured by the meter which may already be installed. The customer guarantees that he will use current to the value of at least $3 per month. The card also gives a clear schedule of charges for two, three, four and five hours' burning per night, thirty days in the month.


5c AN HOUR
FOR THE ILLUMINATION OF AN
ELECTRIC SIGN
HOLIDAY GIFTS CUT PRICES
Edison Electric Illuminating Company of Brooklyn

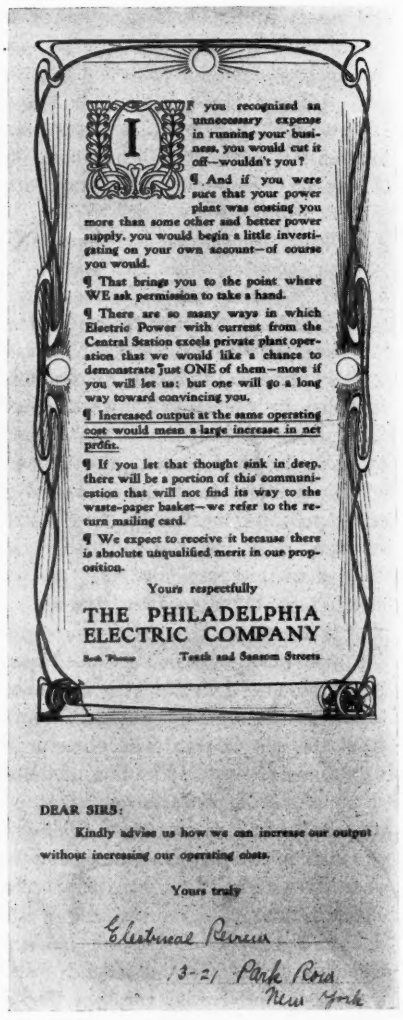
FLYER FROM THE EDISON ELECTRIC ILLUMINATING COMPANY OF BROOKLYN.

Cutting Off Expense

Electrical Review
3-21 Park Row
New York

FOLDER FROM THE PHILADELPHIA ELECTRIC COMPANY.

A mailing folder which presents the subject of the use of electric power to the factory manager in a lucid way, and which occasions him very little effort in responding, is distributed by the Philadelphia Electric Company. This folder is five and one-half inches by fourteen inches, and folds once, so that the written address is made use of both in mailing to the consumer and in returning to the sending company. If the consumer is interested, the addressed card is simply lopped off and put in the mail.


If you recognized an unnecessary expense in running your business, you would cut it off—wouldn't you?

¶ And if you were sure that your power plant was costing you more than some other and better power supply, you would begin a little investigating on your own account—of course you would.

¶ That brings you to the point where WE ask permission to take a hand.

¶ There are so many ways in which Electric Power with current from the Central Station excels private plant operation that we would like a chance to demonstrate just ONE of them—more if you will let us: but one will go a long way toward convincing you.

¶ Increased output at the same operating cost would mean a large increase in net profit.

¶ If you let that thought sink in deep, there will be a portion of this communication that will not find its way to the waste-paper basket—we refer to the return mailing card.

¶ We expect to receive it because there is absolute unqualified merit in our proposition.

Yours respectfully

THE PHILADELPHIA ELECTRIC COMPANY

Both Phones Tenth and Sansom Streets

DEAR SIRS:

Kindly advise us how we can increase our output without increasing our operating costs.

Yours truly

Electrical Review
3-21 Park Row
New York

FOLDER FROM THE PHILADELPHIA ELECTRIC COMPANY.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

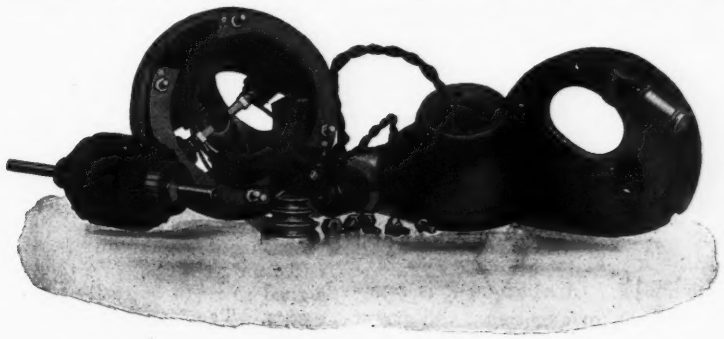
Small Power Motors.

The Fort Wayne Electric Works, Fort Wayne, Ind., has placed on the market a line of small power motors for the operation of numerous mechanisms requiring a light expenditure of power. These motors are made for both alternating-current and direct-current circuits. The direct-current motors of this line are built in sizes up to one and one-half horse-power; the alternating-current motors of this design are built for the operation of mechanisms up to one-thirtieth horse-power capacity. Motors of larger output, such as type E, type EL and type LB, are made for direct-current and for single-phase and multiphase alternating-current systems. The small motors are made in three styles, as follows: type SPD, for direct-current circuits, in capacities up to and including one-thirtieth horse-power; type SPA, for alternating-current circuits, in capacities up to one-thirtieth horse-power; type D, for direct-current circuits only, in capacities from one-tenth to one and one-half horse-power.

TYPE SPD MOTOR OPERATING COPYING MACHINE.

The type SPD construction is as follows: the frame is rigid in construction, and is cast in two pieces from a high grade of iron, uniform in density and free from blow-holes. The two sections of the frame are hemispherical in form, and are supplied with two openings near either end of the shaft, by means of which the commutator and brushes may be examined. These openings also permit free circulation of air within the motor, guaranteeing cool operation. When assembled, the two parts of the frame form a nearly perfect hollow sphere, enclosing both armature and field in a compact manner. The frame is supported upon a separate cast-iron standard, permitting the motor to be located on either floor, wall or ceiling.

The field core is carefully assembled by stacking together laminations of the best quality of steel, each being furnished with sufficient insulation upon its surface to prevent eddy currents. The field is bipolar in design, the laminations being stamped in such form as to provide a magnetic circuit, the poles and pole tips being entirely separate from the cast-iron frame. The two field coils are wound and insulated in separate units. They are made sufficiently flexible to slip over the pole tips, and are finally fitted tightly about the pole and securely fastened in such a manner as to prevent vibration.



PARTS OF TYPE SPD MOTOR.

The armature core is made up of laminations of high-grade sheet steel, stamped in such form that, when stacked upon the shaft with the laminations slightly staggered, a complete cylindrical core is formed, with slots in its surface of constant depth, located at a slight angle with the shaft. The laminations of the core are firmly clamped in place between two brass collars, the latter being securely pinned to the shaft. In the smaller sizes one of the collars is threaded to a thin brass bushing made fast to the shaft, the former being forced into place by means of a key.

The commutator is constructed in a unit by itself, forced upon the shaft and firmly secured in place by means of a set screw, the whole being independent of the armature core.

The armature coils are form-wound, and are forced into the insulated slots of the core and secured by fibre wedges. The armature leads are soldered to slots in each commutator bar.

In order to form a suitable support for the brush-holders, lugs have been cast inside the frame of the motor. These lugs are supplied with a tight-fit fibre bushing, through which the brass brush-holder tube is forced. Within this tube the carbon brushes are free to slide under the pressure of a coiled spring, the amount of compression being regulated from the outside of the motor frame.

The bearings consist of brass bushings accurately centered in the frame of the motor. They are self-oiling, being constantly supplied with oil by means of a wick dipping into oil wells of generous design, supported beneath the bearings. Fibre washers, fixed to the shaft inside the bearings, prevent the oil from creeping to the commutator or armature coils. In assembling, the two halves of the frame are clamped firmly together by means of through bolts, which, in turn, support the field core within the shell. These bolts pass entirely through the shell, and are held in place by brass nuts tightened from the outside.

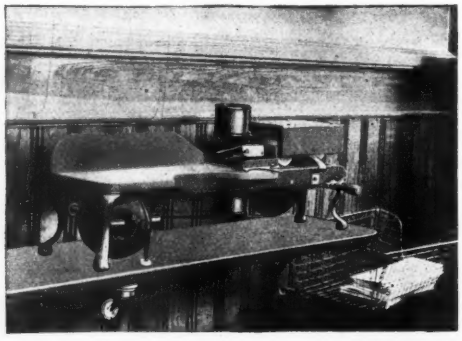
The two forms in which this type of motor is manufactured are practically identical in construction, the distinction being merely in size, method of connec-

tion and output. Both forms are supplied with a three-stage pulley, permitting a variation of speed for the driven mechanism.

Type SPA motors have been designed for use where small amounts of power are desired on alternating-current, single-phase systems. They are similar in appearance to the direct-current, type SPD motor, and have a spherical cast-iron frame with dimensions corresponding to those of the two forms of the direct-current motor.

In operation, type SPA motors depend upon the split-phase induction principle. They are self-starting, and will successfully operate mechanisms requiring power equal to that of the ordinary sewing machine with ease.

Type SPD and type SPA standard motors are furnished with three-step pulleys,



MOTOR OPERATING LETTER-SEALING MACHINE.

so that nearly all mechanisms may be readily operated by means of a belt.

In cases where a special method of driving is desired, using friction discs or a system of gears, the company is prepared to furnish special designs and meet any particular need. In addition, it is sometimes desirable, in adapting small power motors to various demands, to materially change the design of the frame. Special demands of this nature will be undertaken by the company.

In the design of type D motors, great care has been taken to produce a small motor similar in construction and comparable both in efficiency and price with larger types already upon the market.

The frames of type D motors are spherical in form, and consist of four main castings. These comprise a field frame, subbase and two yokes.

In addition to these parts, forms 1SE and 1E are provided with cast-iron cages, so supported between the yokes and the frame as to partially or wholly enclose the motor. These are easily removable without the use of tools, for inspection of commutator and brushes. The cages protect the internal parts from mechanical injury, and also permit sufficient ventilation for the cool operation of the motor. In cases where the motor is to be used in damp places, or near inflammable material, a solid cage is used.

The field frame is cast in one unit from a good grade of steel of high permeability, carefully machined so as to produce a magnetic circuit of low reluctance.

The subbase which is supplied with motors of this type is sufficiently rigid to support the motor upon either floor, wall or ceiling. The two yokes which support the armature bearings are rigidly bolted to the frame in such a manner as to bring the two bearings into accurate alignment. When the motor is to be operated upon either wall or ceiling, it is only necessary to turn these yokes through either 90 or 180 degrees, respectively, in order to bring the oil reservoirs into their normal vertical position.

The field coils of type D motors are designated with four poles, each being supplied with standard interchangeable shunt field windings.

The armature coils are form-wound, and consist of a single length of copper enclosed in an insulating shell. The insulation of the armature is further increased by a suitable lining or insulation, which is placed in the slots of the laminated soft-steel core before the coils are put in place.

The commutator, which is constructed and mounted upon the shaft entirely separate from the armature core, is made up of forged copper segments insulated with mica. The segments are rigidly held in place by means of insulated collars, which firmly grip the dovetails cut in the bases of the segments.

The bearings of type D motors consist of bronze sleeves rigidly held in place by cast-iron yokes. These sleeves are designed so as to be easily replaced if necessary. The bearings are supplied with oil by means of standard ring oiling devices operated in a reservoir of large capacity.

The spider which supports the brush-holder is fitted to the bearing in such a manner as to be easily removable with the end-bearing yoke. The design of the brush-holder is particularly simple, the latter comprising the smallest number of parts consistent with good mechanical construction. There are no sliding contacts between the brush and the brush-holder, the two being combined into one unit sufficiently flexible to meet all conditions of service.

Type D motors are shunt-wound, and provided with an insulated terminal board bearing the armature terminals, together with one field terminal, thus providing connections for both the line and the starting rheostats. The motors are supplied with a starting rheostat, carefully designed to bring them up to speed without excessive current.

The Archambault Kerosene Furnace.

The Archambault Company, 15 Cortlandt street, New York city, has placed on the market a kerosene furnace which is finding a remarkable sale among electricians, tinsmiths and plumbers. The inventor of this furnace, Mr. Arthur J. Archambault, formerly a plumber by trade, was employed from 1890 to 1897 as a cable-splicer for the Southern New England Telephone Company. Later he was in the employ of the New York Telephone Company as a cable-splicer. During his work in this field he became acquainted with the objections raised by the insurance underwriters to the use of gasoline in connection with cable-splicers' furnaces in buildings. He devoted a great deal of his time to the evolving of an idea which had occurred to him, of making a plumbers' furnace operated by kero-

THE ARCHAMBAULT KEROSENE FURNACE.

sene instead of gasoline. About a year ago he constructed a furnace, and after four months of experimenting he succeeded in turning out a kerosene furnace and blow-torch which was immediately approved by some of the largest plumbers' supply houses in New York city. During the following four months he placed some four or five hundred on the market, these being rapidly taken up by the various telephone, electric light and street railway companies, and by plumbers in various sections of the country.

The demand for this apparatus became so extensive, and so far exceeded his expectations, that he found it necessary to organize a company with sufficient capital to manufacture and sell the furnaces on a larger scale. The Archambault Company has been organized under the laws of the state of Connecticut, with an authorized capital stock of $50,000. The directors of the company are as follows: George A. French, Hartford, Ct.; George T. Manson, Montclair, N. J.; Ellis B. Baker, New Haven, Ct.; Judge Albert C. Bill, Hartford, Ct., and Arthur J. Archambault, New York city. The offi-

cers of the company are: George A. French, president; George T. Manson, vice-president; Ellis B. Baker, secretary and treasurer; Arthur J. Archambault, superintendent. The business offices of the company are located at 15 Cortlandt street, New York city, and a temporary factory has been secured and is in operation at Rutherford, N. J.

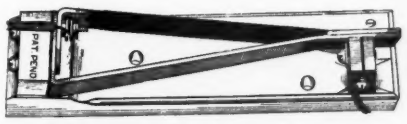
The directors of the company are well known to the electrical fraternity. George A. French was for a dozen years connected with Peck Brothers & Company, of New Haven, Ct., manufacturers of plumbers' supplies and specialties, and more recently for several years was the local manager of the Southern New England Telephone Company's Hartford exchange. George T. Manson is the well-known general superintendent of the Okonite Company, New York city. Mr. Baker was formerly general superintendent of the Southern New England Telephone Company. Judge Bill, in addition to being the senior member of the law firm of Bill & Tutle, is president of the board of police commissioners of Hartford, Ct.

The new company has not made much of an attempt to push the sale of the furnace, owing to the extraordinary demand and the fact that it has commenced business with a very large number of orders. Arrangements are being made, however, to enable the company to meet this emergency promptly, and it will soon be in shape to fill orders of any magnitude.

The furnaces are shipped in crates, singly, and also in crates of one dozen each. The price is such that the saving in the cost of kerosene under that of gasoline for a year's consumption would pay for two furnaces. Special discounts are made for orders by the dozen or gross.

An Automatic Motorless Flasher.

The Advertising Mirrorgraph Company, Hudson avenue and Concord street, Brooklyn, N. Y., has placed on the market an ingenious apparatus which it designates as the "Thermo Blink." This apparatus depends on the well-known application of thermoelectric laws for its operation. The apparatus, the maker claims, is not affected by outside temperature changes. The flasher is fitted with a clamping binding-post for holding a platinum-pointed screw, which allows of a delicate adjustment. The contacts are of platinum, and the apparatus is made to stand shipping and rough handling.



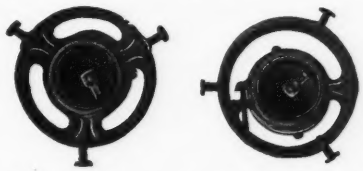
AUTOMATIC MOTORLESS FLASHER.

The flasher is manufactured in three sizes, as follows: No. 1, 110 volts, one to four sixteen-candle-power lamps; No. 1-A, 220 volts (to order); No. 2, 110 or 220 volts, six to twelve sixteen-candle-power lamps, or their equivalent.

Electrolier Key Socket and Combined Socket and Shade-Holder.

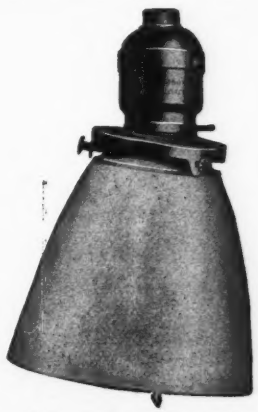
The electrolier key socket, shown herewith, designed a short time ago by the engineers of the General Electric Company, Schenectady, N. Y., is noteworthy in that it is very compact and has a well-finished appearance, harmonizing with decorated electroliers. It has a neat metal key, which is thoroughly insulated from all live parts. This key is removable, and an extension key may be used in its place.

ELECTROLIER KEY SOCKET.



COMBINED SOCKET AND SHADE-HOLDER.

The combined socket and shade-holder shown herewith, designed by the General Electric Company, has met with the approval of many users. The shade-holder in the new device is permanently attached to the socket shell in such a way that it can not slide or turn. This, together with the fact that three points of support are afforded the shade, eliminates any sagging.



METHOD OF ADJUSTING COMBINED SOCKET AND SHADE-HOLDER.

A New Portable Testing Instrument.

The Troy Electrical Company, 1924 Sixth street, Troy, N. Y., has placed on the market a new portable testing instrument designed for the use of electricians, electrical engineers, street railway men, central station operators and isolated plants. The apparatus is so constructed that it can be produced at a small price, but at the same time the company guarantees its accuracy and durability.

NEW PORTABLE TESTING INSTRUMENT.

The apparatus is claimed to be practically dead-beat, the pointer coming to rest promptly. There is no magnetic lag, and the temperature correction is negligible. The instruments, the manufacturer claims, may be left in circuit continuously, and as they are direct-reading, no multiplying constant is necessary.

Due to the simplicity of construction, these instruments are not liable to get out of order, and the repair bill is consequently very low. The instruments may be used in any position, and the maker guarantees them fully on all the aforementioned points.

The "Ever Ready" Dry Battery.

The American Electrical Novelty and Manufacturing Company, New York city, is meeting with a remarkable success with its large-sized dry battery. The company claims that it has solved the electrical problem of making a high-amperage cell that still retains its life; and on the shelf it is claimed that this cell will last fifty per cent longer than the ordinary dry battery. That the battery is giving satisfaction is evidenced by the demand for it from all quarters of the world.

The battery has been adopted by a large number of leading gas and gasoline engine manufacturers, as well as motor-boat and motor-cycle concerns.

It is announced that the "Ever Ready" battery has just received the highest award of the gold medal at the Lewis and Clark Exposition, Portland, Ore. This is stated to be not only for initial amperage and voltage, but for long life and high recuperative powers.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

LARGE ELECTRIC RAILWAY SCHEME FOR ILLINOIS AND WISCONSIN—It is announced that Farson, Leach & Company, of Chicago, Ill., are back of a scheme to control and build electric interurban railways to connect a number of the leading cities of Illinois and Wisconsin. It is expected that some $10,000,000 will be expended.

NEW ROAD BETWEEN PATERSON, N. J., AND NEW YORK CITY—The board of directors of the New York & New Jersey Rapid Transit Railway Company has decided to begin at once the work of constructing a new electric road between Paterson, N. J., and New York city. It is estimated that the cost of building the road will be about $8,000,000. The greater part of the expense will be for boring a tunnel through the road near Weehawken. Colonel William Barbour is president of the new company.

IMPROVEMENTS TO THE POWER PLANT AT BELLINGHAM, WASH.—Messrs. Stone & Webster, of Boston, have purchased the Nooksack power plant from the Bellingham Bay Improvement Company. It is announced that the company will immediately expend $200,000 in bringing the capacity of the plant up to 2,000 horse-power, the ultimate plans being to invest $1,000,000, and to generate 25,000 horse-power. The Bellingham Bay Improvement Company has already expended $150,000 in the preliminary work of harnessing the waterfall fifty miles east of Bellingham, Wash., in the Cascade mountains.

MEXICAN ELECTRICAL NOTES—The installation of a hydro-electric plant at the junction of the Bolaños and Santiago rivers, near the dividing line between Jalisco and Tepic, is being considered by Carlos Romero, owner of the Mololoa mine. An investigation is now under way and estimates will be prepared. It is proposed to use the water of the Bolaños river and to generate initially some 2,000 to 3,000 horse-power. Some of the current will be used at the mine, which is eighteen kilometres distant from the projected site of the plant, and the remainder will be sold for power and lighting purposes.

MISSOURI VALLEY ELECTRIC RAILWAY—Official announcement has been made of the formation of the Missouri Valley Electric Railway with a capitalization authorized of $7,500,000, of which $5,000,000 is to be issued, and $7,500,000 of five per cent thirty-year bonds, of which $5,000,000 is to be issued. The new company will be controlled almost entirely by Cleveland capital. The line will run from Kansas City to St. Joseph, with connections into Leavenworth and Atchison. The total length of the line will be sixty-six miles, and it is the intention to double-track from Kansas City to Leavenworth, making the total length of track ninety-five miles. The new line will extend along the Missouri bank of the Missouri river.

NEW POWER COMPANY IN UTAH—The Telluride Power Company is contemplating the erection of a power plant on the Duchesne river for the purpose of furnishing light and heat for Park City, Salt Lake City, Bingham, Mercur, Price and other places in Utah. The diverting works will consist of dams, headgates, dykes and other necessary improvements and releasing devices, and the water will be conveyed to the power plant by means of a channel 60,700 feet long. Three Pelton wheels, operating under a head of 1,485 feet, will furnish a total of $7,500 horse-power. The water is to be diverted from the Duchesne at several different points, and conveyed by a system of conduits to the place where the power plant is to be erected, and the power will be distributed over transmission lines to the various cities.

THE PACIFIC GAS AND ELECTRIC COMPANY—The Pacific Gas and Electric Company filed articles of incorporation on October 10 in San Francisco, Cal. This company has been formed by N. W. Halsey & Company to take over the California Gas and Electric Corporation and the San Francisco Gas and Electric Company. The capital is $30,000,000, divided into 300,000 shares of the par value of $100 each. There is $10,000,000 in six per cent cumulative preferred, and $20,000,000 in common stock. The directors are E. J. De Sabla, Jr., John Martin, Frank G. Drum, John A. Britton, Garret W. McEnerney, John S. Drum, Cyrus Pierce, Carl Taylor, George K. Weeks, Frank D. Stringham, Merrill O. Evans, Jr., Alexander N. Kemp, George W. Levis, C. R. Parker and L. Foster Young. The company's principal place of business will be in San Francisco.

HIGH PRICE FOR INDEPENDENT TELEPHONE FRANCHISE IN NEW YORK CITY—The special report of Harry P. Nichol, engineer of the finance department of the board of estimate for the city of New York, on the value of the franchise sought by the Atlantic Telephone Company, has been presented. Under the terms fixed by Mr. Nichol, the company would have to pay the city $7,750,000 in twenty-five years as a minimum for the privilege of entering the local field. The Atlantic Telephone Company placed its application before the board of estimate several weeks ago, and it was referred to the finance department. The company offered the city 500 telephones free of charge. It also offered a five-cent call in any one borough, a ten-cent rate for calls from one borough to another. The rate for unlimited residence service was fixed at $66 per year, and for business, $108. For the franchise the company offered to pay the city a percentage of its gross receipts—one per cent for the first two years; two per cent for the next three years; and four per cent for the succeeding twenty years.

MERGER OF PENNSYLVANIA AND OHIO LINES—The merger of the Pennsylvania & Mahoning Valley Railway Company, operating the Newcastle and interurban lines of Youngstown, Niles and Warren, and the Sharon & Newcastle Street Railway Company, controlling the local lines of Sharon and the interurban lines of Youngstown and Newcastle, has been ratified by the stockholders. It has been decided to accept the offer made by J. W. Blackburn, of Youngstown; Mr. Barton, of Cleveland, and others, for the transfer of the property of the two concerns. The new company is the Mahoning & Shenango Railway, Light and Heat Company. The deal involves about $5,000,000 worth of railway property and valuable franchises. The company will expend about $3,000,000 in extensions and improvements as soon as stock to the amount of $10,000,000 has been issued. One of the extensions will be a line from Newcastle to Mercer, through New Wilmington. It is also announced that the deal has practically been closed for the sale of the Titusville Traction Company to Murray A. Verner, of Pittsburg, and the McClure Syndicate, of Philadelphia.

NEW MANUFACTURING AND CONSTRUCTING COMPANIES.

LANSING, MICH.—The Detroit Electrical Novelty Company, with a capital of $30,000, has been incorporated.

WACO, TEX.—The Waco Auto and Electric Company has been incorporated with a capital of $5,000 by M. T. Bell and others, to deal in automobiles and electrical supplies.

DOVER, DEL.—The Cooper Electric Safety Gate Company has been incorporated with a capital of $150,000, to manufacture electrical devices, signals and automatic appliances.

ALBANY, N. Y.—The H. G. Pape Electric and Manufacturing Company, of Buffalo, has been incorporated by Herman G. Pape, I. B. Pape and William A. Peters, of New York city.

PORTLAND, ME.—The Universal Acoustic Company has been incorporated to manufacture electrical appliances. The capital stock is $250,000, and the officers are: president, H. L. Cram; treasurer, A. F. Pine, both of Portland.

JERSEY CITY, N. J.—The American Stark system has been incorporated with a capital of $100,000, to acquire the letters patent granted to Alexander M. Stark covering certain improvements in a combined telephone, telegraph, electric light and power system. The incorporators are: Henry A. Bingham, Richard F. Tully, Cornelius A. Cole, Jersey City.

TELEPHONE AND TELEGRAPH.

BYRON, N. Y.—The Byron Telephone Company is building five miles of new line.

RICHMOND, VA.—The Petersburg Telephone Company will place its wires underground.

BALTIMORE, MD.—A telephone line in St. Mary's County is to be extended from Laurel Grove to Oak Point.

NEWARK, N. J.—The Franklin Telephone Company has begun the erection of its trunk line to Flemington.

MINNEAPOLIS, MINN.—An extensive rural telephone system is being planned for the district beyond Robbinsdale.

EBENSBURG, PA.—The Huntingdon & Clearfield Telephone Company has opened its new exchange at Ebensburg.

ANN ARBOR, MICH.—The Michigan Telephone Company has been granted permission to place its wires underground.

NORTH STERLING, CT.—The Southern New England Telephone Company will erect a line from Danielson to North Sterling.

PUEBLO, COL.—The Colorado Telephone Company has begun laying conduits preliminary to placing its wires underground.

MINNEAPOLIS, MINN.—The Northwestern Telephone Company will this fall lay the foundation for an enlargement of its present building.

TERRE HAUTE, IND.—The Nordella Construction Company has been awarded the $40,000 contract for the Central Union telephone building.

ALBERT LEA, MINN.—The Northwestern Telephone Exchange Company has acquired a controlling interest in the Albert Lea Telephone Company.

OAKLAND, CAL.—The Sunset Telephone Company will erect in East Oakland a new building to cost $35,000, and install equipment to the amount of $70,000.

RAWLINS, WYO.—It is reported that a private telephone company is to be organized to build and operate telephone lines in Rawlins and the surrounding towns.

MILWAUKEE, WIS.—At a special meeting of the Sheboygan common council it was decided that the city cooperate with the Citizens' Telephone Company in building conduits.

CORNING, N. Y.—The Citizens' Telephone Company is making preparations to reconstruct its system and enlarge its business, and expects to expend between $35,000 and $40,000 for the purpose.

INDEPENDENCE, MO.—The Bell Telephone Company has placed in operation a new switchboard, with a capacity of 2,000 telephones. The service has been otherwise improved, at a cost of $35,000.

BROOKLYN, N. Y.—The New York & New Jersey Telephone Company has prepared plans for a four-story and basement telephone exchange building, of brick, with stone trimmings, to be built at Jamaica.

WASHINGTON, D. C.—The war department has granted a revocable license to the Western Union Telegraph Company for the stringing of telegraph wires along the approaches and on the Potomac highway bridge.

SOUTH BEND, IND.—Superintendent Corbett, of the Western Union Telegraph Company, has announced that the company will place its wires in the business district of South Bend underground within the near future.

FOLEY, MINN.—The Twin City Telephone Company has closed a deal for the Maple Leaf Telephone Company, of Foley, and it is reported that a line will be run from Santiago, Sherburne County, to Foley, to connect with the local exchange.

PONTIAC, ILL.—The articles of incorporation of the Odell Telephone Company have been filed in the circuit clerk's office. The officers named are: A. Des Voignes, president; O. E. Des Voignes, vice-president; Geo. Des Voignes, secretary-treasurer.

LAFAYETTE, IND.—The Tippecanoe Telephone Company has been sold to the Central Union Company for a consideration of $22,000. The deal gives the Bell company 180 miles of wire running through Romney and Linden, thence to Crawfordsville.

CHESTER, PA.—The Bell Telephone Company has made a new rule regarding the tolls between Philadelphia, Chester, Media and other towns. Heretofore the rate has been fifteen cents per call to Philadelphia and other points, but it is now reduced to ten cents.

TOLEDO, OHIO—The directors of the Toledo Home Telephone Company have decided to increase the wages of all its operators about ten per cent. The increase is entirely voluntary. The directors also declared the customary one per cent quarterly dividend.

BORDENTOWN, N. J.—The following have been elected as directors of the Bordentown Telephone and Telegraph Company for the ensuing year: John P. Hutchinson, Fred G. Wiese, John Enright, Barker Gummere, Jr., H. R. Schwartz, F. A. Demorest, William S. Hancock.

WHEATLAND, CAL.—A. C. Stagner, E. T. Manwell and W. F. Coffin have been appointed by the Wheatland chamber of commerce to confer with the board of directors of the Marysville chamber of commerce in regard to establishing a station in the town of Marysville for the independent telephone line.

DALLAS, TEX.—The city council of Texarkana, Ark., has accepted the $5,000 indemnity bond offered by the Southwestern Telegraph and Telephone Company in order to secure its charter. The bond requires that work on the proposed exchange improvements be finished at a specified date, otherwise the bond is forfeited.

BUFFALO, N. Y.—At the annual meeting of the Frontier Telephone Company, the following directors were elected: William H. Andrews, Charles E. Austin, Martin Carey, Robert W. Chapin, William A. Douglas, Charles W. Goodyear, R. R. Hefford, Burt G. Hubbell, Clark L. Ingham, Andrew Langdon, F. C. M. Lautz, H. H. Littell, E. C. Lufkin, H. H. Persons, George A. Plimpton.

LITCHFIELD, ILL.—The stockholders of the Montgomery County Telephone Company have elected the following directors: A. G. Butler, Dr. M. L. Moyer, G. W. Rainey, A. K. Vandiver, August Kellenburger, H. H. Zimmerman, C. H. Poland, George D. Taylor and Robert Barnard; C. H. Poland was chosen president, H. H. Zimmerman vice-president and Robert Barnard secretary and treasurer.

PIERRE, S. D.—Articles of incorporation have been filed for the Great Western Telephone Company, at Chamberlain, with a capital of $25,000. The incorporators are Warren Young, David Henry and Frank B. Rowe. The purpose of the company is the construction of a telephone line westward from Presho along the proposed line of the Milwaukee railroad. Mr. Rowe already owns a line from Chamberlain to Presho, and from there to Pierre. The new line will be an extension of this property.

CINCINNATI, OHIO—S. A. Hoskins, of Wapakoneta, Ohio; John A. Quisenberry, of Danville, Ky., and Frederick Bimel, of Portland, Ind., a committee representing the bondholders who purchased the properties of the Commercial Telephone Company, operating in central and southern Texas, sold under receivership proceedings, have reorganized the company, increased the capital stock to $500,000 and mapped out work for the projection and equipment of the system, which now extends over 1,000 miles.

DOYLESTOWN, PA.—The following officers have been elected by the Franklin Telegraph and Telephone Company: president, H. S. Funk; secretary, H. H. Funk; treasurer, Josiah Weireback. The company was chartered August 5, 1905, the capital stock being $5,000. The officers and the following comprise the board of directors: J. J. Ott, N. S. Rice and Granville Hollenbach. The line will be built from Riegelsville to Durham Furnace, to Durham, Springtown, Pleasant Valley, Richlandtown to Quakertown.

ST. LOUIS, MO.—The Quincy Telephone Company, of Quincy, Ill., which procured its franchise about a year ago, has sold its $500,000 issue of bonds to a St. Louis syndicate, which includes J. H. Murphy, a broker, and Charles Sutter. The firm of Herman & Schatzman, of Quincy, is understood to be financing the project. The work of construction will begin immediately, and is expected to be completed by next April. Long-distance connections will be made with St. Louis and Chicago, and about 5,000 telephones will be installed.

NEW INCORPORATIONS.

BARNUM, IOWA—Barnum Telephone Company. $10,000.

RALEIGH, N. C.—Piedmont Telephone Company. $10,000.

LOUISVILLE, KY.—Fern Creek Telephone Company. $999.

MINNEAPOLIS, MINN.—St. James Telephone Company. $25,000.

DES MOINES, IOWA—Dayton Heat and Light Company. $10,000.

SAN FRANCISCO, CAL.—General Electric Power Company. $1,000,000.

LINCOLN, NEB.—Gothernburg & Northern Railway Company. $5,000,000.

MADRID, N. Y.—Madrid Telephone Company. Increased from $10,000 to $15,000.

SPRINGFIELD, ILL.—Chicago, Evanston & North Shore Railway Company. $10,000.

GUTHRIE, OKLA.—Willow Telephone Company. $1,000. Incorporators: L. C. Cusins, J. W. Berry and others.

OLYMPIA, WASH.—Spokane-Palouse Light and Power Company, Spokane. $100,000. Incorporators: W. E. Goodspeed, F. G. Kiesow, B. H. Kiser.

SPRINGFIELD, ILL.—North Star Telephone Company, Glasford. $2,200. Incorporators: Andres Northrup, M. R. Turpine, C. W. Rusch.

LOS ANGELES, CAL.—Santa Paula Home Telephone Company. $60,000. Directors: Charles F. Guthridge, M. Zahn, Arthur Wright, D. F. Boyce, C. P. Platt, of Los Angeles.

EAST LIVERPOOL, OHIO—East Liverpool & Youngstown Railroad. $5,000. Incorporators: U. C. DeFord, N. B. Bellingsley, B. W. Johnson, M. E. Johnson and C. B. Kenty.

CLEVELAND, OHIO—The Cleveland, Berea & Southern Railway Company. $1,000. Incorporators: C. C. Downs, W. S. Mitchell, William G. Benedict, Frank J. Cowdery, Solomon Peskin.

INDIANAPOLIS, IND.—Louisville & Indianapolis Traction Company, Jeffersonville. $10,000. Directors: J. B. Schindel, Maurice Cahill, Samuel Adams, Charles Rodman and A. L. Barker.

COLUMBUS, OHIO—Steubenville & Wellsburg Traction Company, Steubenville. $10,000. Incorporators: Dohman J. Sinclair, Joseph Canahan, R. McGowan, Jared Dunbar and Michael Keane.

SOUTH McALESTER, I. T.—Washita Valley Interurban Electric Company, Tishomingo. $12,000,000, with $7,000,000 subscribed. Incorporators: W. T. Croslen, J. G. V. Redmon, M. R. Morris.

MADISON, WIS.—Rush River & Eau Galle Telephone Company, Baldwin. $3,520. Incorporators: Lewis Crogen, Edward Christensen, Andrew T. Sabby, Albert Geisness and Thomas Nelson.

RICHMOND, VA.—Willoughby Bay Traction Company. $50,000. Officers: H. L. Smith, president and general manager; J. N. Vaughan, vice-president; C. H. Consolvo, secretary and treasurer.

DES MOINES, IOWA—Soldier Valley Mutual Telephone and Telegraph Company, of Ute. $5,000. Directors: S. D. Crary, B. C. Stewart, E. B. Ullrich, C. J. Bartels, Henry Witte, Joseph M. Carritt, Adam Feuerbach.

SAN FRANCISCO, CAL.—The Union Power and Light Company. $2,000,000. Directors: John Martin, M. Fleishhacker, R. E. Wallace and H. A. Cook, of San Francisco; Frank H. Brack, of Vacaville; John Humphrey and R. Kirman, of Reno.

COLUMBUS, OHIO—East Liverpool Traction and Light Company. To connect East Liverpool, Wellsville, Steubenville and Bellaire. $6,000. Incorporators: Van Horn Ely, N. B. Bellingsley, E. D. McDonell, S. B. Davies and M. J. McGraw.

GREELEY, COL.—Northern Telephone Company. To maintain a telephone service in northern Colorado. $250,000. Officers: C. H. Ramsay, of Greeley, president; T. M. Callahan, of Longmont, and Dr. H. C. Bennett, Greeley, vice-presidents; S. H. Southard, Greeley, secretary and treasurer.

INDIANAPOLIS, IND.—Indianapolis, Vincennes & Evansville Electric Railway Company. $100,000. Directors: Z. B. East, J. L. Ebner, William A. Cullop, Peter Schloot, Gilbert H. Hendren, Charles M. Cooper, William N. Matthews, W. S. Johnston, Absalom N. Fisher, George D. Thornton and Cyrus E. Davis.

SPRINGFIELD, ILL.—Oglesby & Granville Railway Company. To be constructed from the Vermillion river, near Portland, La Salle County, Ill., in a westerly direction to the village of Granville, Putnam County, Ill. $250,000. Incorporators and first board of directors: S. T. Crapo, Detroit, Mich.; A. Uhrlaub, Albert G. Mang, E. L. Read and H. E. Hallenbeck, all of Chicago.

ALBANY, N. Y.—The Elmira, Corning & Waverly Railway, Elmira, N. Y. To construct an electric road thirty-seven miles long. $2,500,000. Directors: Senator William J. Tully, of Corning; G. Tracy Rogers, of Binghamton; A. N. Brodhead and Arthur C. Wade, of Jamestown; Joseph A. Powers and James H. Caldwell, of Troy; Thomas O'Connor, of Waterford; Frederick E. Hawkes and William L. Watrous, of Waverly; George McCann and A. Lee Smith, of Elmira, N. Y.

PERSONAL MENTION.

MR. J. W. KRUEGER, who has been identified with an electrical supply house in St. Louis for some time, is now associated with the Manhattan Electrical Supply Company, New York city.

MR. FRANK BURTON, a former lineman for the Southwestern Telephone and Telegraph Company, has been promoted to the managership of the Humble (Tex.) exchange of the same company.

MR. JUDSON SMITH, Scranton, Pa., who has been associated with the Consolidated Telephone Company for several years, has been appointed superintendent of the Anthracite Telephone Company, with headquarters at Forest City, Pa.

MR. WILLIAM T. HARPER, manager of the Ansonia-Derby division of the Southern New England Telephone Company, has been transferred to Meriden, Ct. Mr. Harper will be succeeded in the Ansonia division by Mr. W. N. Sperry, of Derby.

MR. R. W. BIVINS, Springfield, Ill., has been appointed superintendent of the electric light plant owned by the Jerseyville (Mo.) Illuminating Company, to succeed Mr. J. J. Miller, resigned. Mr. Bivins was formerly connected with the lighting plants at Decatur and Arcola, Ill.

MR. HENRY ABBOTT, president of the Calculagraph Company, New York city, is the author of a very interesting article appearing in the September 1 issue of *American Industries*, entitled "The Beginning of a Cost Accounting System." Mr. Abbott's article contains, among other particularly interesting data, a very significant reference to the value of the proper business ideas in the timing of messages in telephone stations.

MR. H. M. KLINGENFELD, manager of the advertising department of the National Electric Company, Milwaukee, Wis., has resigned, and on November 1 will enter the advertising department of the David Williams Publishing Company at its western office. Mr. Klingenfeld has had a wide experience in all lines of the manufacturing and advertising departments of several large companies, and will undoubtedly be uniformly successful in his new position.

MR. C. A. GREENIDGE, who has been superintendent of the electrical department of the Utica (N. Y.) Gas and Electric Company, has been promoted to the position of general manager of that department. Mr. William J. Cahill, who has been general manager of the gas department and secretary of the company, has retired as secretary, and Mr. M. J. Brayton, whose place at the head of the electrical department Mr. Greenidge takes, has been appointed secretary.

MR. CECIL B. SMITH, formerly chief engineer of the Niagara, Lockport & Ontario Power Company, and now in the employ of the Temiskaming & Northern Ontario Railway and the Ontario Hydroelectric Power Commission, has left his work in Canada and departed for Europe to gather information on electric railway equipment abroad. He will study especially the electric locomotives of Italy, Switzerland, Germany, France and England. It is the intention of the power commissioners to equip the new Ontario railway with electric locomotives in the near future. The commission desires, however, to investigate the feasibility and practicability of such a road under the operating conditions which prevail abroad.

ELECTRICAL SECURITIES.

Speculation in securities was practically at a standstill during the past week. Prices moved irregularly, and although there is little apprehension, a general downward tendency was manifest. Notwithstanding the conservatism which is very evident in all quarters, there is every indication that there is a widespread industrial activity and prosperity. The agricultural situation continues very hopeful, and the crop report is stated to be all that has been expected even in the most sanguine moments. While there is a surplus of grain and other cereals, the bad position of the foreign supply will surely make a market for whatever surplus we may have here, and will, no doubt, create an additional prosperity before the holidays arrive.

ELECTRICAL SECURITIES FOR THE WEEK ENDING OCTOBER 14.

New York:	*Closing.*
Brooklyn Rapid Transit	72
Consolidated Gas	186
General Electric	179⅛
Interborough Rapid Transit	213½
Kings County Electric	200
Manhattan Elevated	165¼
Metropolitan Street Railway	126
New York & New Jersey Telephone	168½
Westinghouse Manufacturing Company	190

The Metropolitan Street Railway Company has applied for permission to list on the Stock Exchange $1,284,000 additional refunding 4 per cent bonds of 2002.

A special meeting of the stockholders of the New York & New Jersey Telephone Company will be held October 25 in Brooklyn, N. Y., for the purpose of voting upon a proposition to increase the capital stock from $15,000,000 to $50,000,000. Of the increase authorized on March 1, 1904, from $8,000,000 to $15,000,000, there remains $1,220,900. The rapid development of the business of the company, and the necessity for large additions to the plant, make it advisable in the judgment of the directors to provide for enlargement of the capital stock.

The stockholders of the Western Union Telegraph Company have elected Harris C. Fahnestock and Thomas H. Hubbard directors, succeeding A. R. Brewer, resigned, and Charles Lockhart, deceased. Other directors were reelected. The board is now made up as follows: Thomas T. Eckert, Robert C. Clowry, John T. Terry, Russell Sage, Samuel Sloan, George J. Gould, Edwin Gould, Louis Fitzgerald, Charles Lanier, J. Pierpont Morgan, Chauncey M. Depew, Henry M. Flagler, John Jacob Astor, Oliver Ames, C. Sidney Shepard, John B. Van Every, Jacob H. Schiff, James Stillman, Thomas F. Clark, William L. Bull, James H. Hyde, Morris K. Jessup, Frank J. Gould, E. H. Harriman, Samuel Spencer, Howard Gould, John J. Mitchell, Henry A. Bishop, Harris C. Fahnestock, Thomas H. Hubbard.

The New York City Railway Company has issued its annual report for the year ended June 30, as follows: gross, $20,888,124; expenses, $12,271,423; net, $8,616,701; other income, $444,603, a total of $9,061,304; taxes, rent, interest, etc., $11,858,246, leaving a deficit of $2,796,942. The deficit for the year of $2,796,942 includes $168,960 accrued to the Metropolitan Securities Company for dividends upon its holdings of Third Avenue Railroad Company capital stock. The deficit will be further increased by the amount of the special franchise tax when ascertained. The amount of this tax for the fiscal year based upon the assessment for the calendar year 1904, as claimed by the state, and after deducting various franchise payments to the city and certain reductions conceded by the state, is $537,374.

Boston:	*Closing.*
American Telephone and Telegraph	137½
Edison Electric Illuminating	250
Massachusetts Electric	56½
New England Telephone	137
Western Telephone and Telegraph preferred	95

The annual report of the Edison Electric Illuminating Company of Boston, for the year ended June 30, shows gross earnings of $3,346,027, an increase as compared with last year of $220,511. In spite of an increase in expenses of $133,415, net earnings show a gain of $87,096. Total net income for the year was $1,236,207, and after deducting $1,164,791 for interest and dividends there remained a surplus of $71,416, a decrease as compared with 1904 of $5,992. Directors were reelected at the annual meeting. A regular quarterly dividend of 2½ per cent has been declared, payable November 1.

Philadelphia:	*Closing.*
Electric Company of America	11¼
Electric Storage Battery common	83
Electric Storage Battery preferred	83
Philadelphia Electric	9
Philadelphia Rapid Transit	27⅞
United Gas Improvement	96½

Chicago:	*Closing.*
Chicago Telephone	135
Chicago Edison Light	159½
Metropolitan Elevated preferred	70
National Carbon common	61
National Carbon preferred	116
Union Traction common	13½
Union Traction preferred	37

The Chicago Edison Company has sold electric current equal to 7,000 horse-power on long contract to the Chicago City Railway Company. During the next two years the Edison Company plans to expend $4,000,000 in improvements.

Metropolitan West Side Elevated has issued its usual annual statement for the year ended June 30. The income account is as follows: gross, $2,224,968; expenses, $1,112,736; net $1,112,232; other income, $7,193, making the total $1,119,425; charges, $889,283, leaving a surplus of $230,142, equal to 1.39 per cent on the $16,500,000 capital stock.

ENGINEERING SOCIETIES.

AMERICAN ELECTROCHEMICAL SOCIETY—At a meeting of the board of directors of the American Electrochemical Society, held September 2, Dr. R. von Foregger and Mr. C. A. Wells, Jr., both of New York city, were elected to membership.

BOSTON SECTION OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS—At a meeting of the Boston section of the American Institute of Electrical Engineers, the following officers were elected for the ensuing year: chairman, C. A. Adams; secretary, H. D. Jackson. Executive committee—C. L. Edgar, James I. Ayer, C. B. Burleigh, Dr. A. E. Kennelly and R. Fleming.

LEGAL NOTES.

TESLA SPLIT-PHASE MOTOR—In the United States Circuit Court for the District of Massachusetts, Judge Lowell filed an opinion on September 22 in the Tesla split-phase motor suit, Westinghouse Electric and Manufacturing Company, complainant, *versus* Stanley Instrument Company, defendant, granting a motion for a preliminary injunction.

WIRELESS INFRINGEMENT SUIT—Judge Wheeler, in the United States Circuit Court, handed down a decision on October 16 in the case of the National Electric Signaling Company against the De Forest Wireless Telegraph Company, for alleged infringement of a patent sustaining three of the twenty-nine claims made by the plaintiff. The court adds that four of the claims are so general as to leave their validity and application doubtful, and they are not passed upon.

SERIES MULTIPLE DISTRIBUTION CASE—In the case of the Thomson and Rice patent No. 413,293, the Thomson-Houston Electric Company, complainant, *versus* the Salem Electric Company, defendant, Judge Lanning filed an opinion in the United States Circuit Court for the District of New Jersey on September 19, adjudging the defendant infringer of the first, third, fourth and sixth claims of the patent in suit, and requiring the defendant to account for profits.

ELECTRIC LIGHTING.

DOWNIEVILLE, CAL.—W. Dubuque has purchased the interest of Tony Costa in the local electric light plant.

WILMINGTON, DEL.—An electric light line will be run from New Castle to Delaware City to furnish light to the latter place.

MARION, IND.—The Reynolds Electric Company, of Marion, is installing at the LaRuche Glass Company's plant, at Matthews, a plant of 500-light capacity.

AKRON, N. Y.—The Niagara, Lockport & Ontario Power Company has filed with the Akron town clerk an acceptance of the franchise granted to it recently.

SOUTH LYON, MICH.—The village of South Lyon has bought the electric light building and equipment of J. R. Blackwood, and will run its own lighting system hereafter.

ELLWOOD CITY, PA.—The Ellwood Electric Light Company has completed arrangements by which it will conduct electricity to Zelienople for lighting and power purposes.

MAYFIELD, CAL.—A contract, calling for an expenditure of $400 a month for street lights, has been awarded to the Redwood City Electric Company by the Mayfield town trustees.

GALION, OHIO—According to the statement issued by the service department, the cost of maintaining and operating the arc street lamps of Galion by the municipal plant is twenty-seven dollars a light per year.

ROCKVILLE, ONTARIO—By a vote of 427 to 165 the by-law to raise $50,000 for improvements and extensions to the electric lighting and waterworks plants of the city of Woodstock was carried by the property holders.

MONROE, MICH.—The Monroe council has appropriated $5,000 for the rewiring of the city and for installing electric meters. This is the first step toward improving the municipal lighting plant. The River Raisin will furnish the necessary power.

MILWAUKEE, WIS.—Mayor Rose has signed the resolution which provides that $60,000 from the earnings of the water department be transferred to the general city fund and that the money be used for the purchase of a site for the proposed lighting plant.

HOUGHTON, MICH.—The Great Northern Power Company will have its plant and equipment installed to furnish electrical power to the mines of the Mesaba range by the fall of 1906. A number of the mines have signified their intention to utilize electric power wherever possible.

BALTIMORE, MD.—Subway Engineer Phelps will start at once the construction of a conduit line to Westport to connect with the power-house of the United Electric Light and Power Company. The line will be about 11,000 feet long and will be laid in South Fremont avenue and Ridgely street.

GARNETT, KAN.—The Garnett electric light plant has changed hands, and is now owned by Dr. Milligan, J. Stevenson, J. F. Delinger, C. H. Rice, P. E. Keeney, J. W. Bronston and Leper Adams. J. F. Delinger is president of the company, J. W. Bronston, secretary, and J. H. Stevenson, treasurer and manager.

GLOUCESTER CITY, N. J.—The electric light plant of the Public Service Corporation and the power-house of the Camden, Gloucester & Woodbury trolley road, which is a part of the Public Service, are about to be closed, and the power for the electric lights and trolley road will be supplied from the Camden plant.

NEW YORK, N. Y.—The department of water supply, gas and electricity of Queens has greatly improved the street lighting system of Queens during the past season, until all the principal thoroughfares from Brooklyn and the East river front of Long Island City are now well lighted with electric arc lights of 1,200 candle-power.

ALBANY, N. Y.—The state commission of gas and electricity has granted permission to the Hermon Electric Light Company to issue $15,000 of stock. In the case of the application of the Phœnix Fuel, Light and Water Company, of Phœnix, N. Y., a corporation doing a lighting and water business, the commission consented to the issue of $100,000 of bonds.

GRANTSVILLE, UTAH—The Clark Electric Power Company, with headquarters at Tooele City, has secured a franchise from the city council to erect poles for the instalment of electric lights. Work has been commenced on the erection of poles from Tooele City, a distance of twelve miles, and it is estimated that Grantsville will be lighted by the first of November.

PETERSBURG, VA.—Judge Waddill, of the United States District Court, having authorized the receivers of the Virginia Passenger and Power Company to expend $41,000 for the completion of the work on the water power plant of the company in Dinwiddie County, near Petersburg, the work has been resumed near the dam and a large force of laborers is employed. The company has already spent about $100,000 on the plant.

PHILADELPHIA, PA.—The contract for street lighting for the city of Philadelphia during 1906 has been awarded to the Philadelphia Electric Company. The company was the only bidder for the contract, its bid being $1,073,271.55. This is $118,205.25 less than the estimated cost of the work, the calculations being based on the amount expended this year. Electric lighting cost the city $1,135,508 this year and in 1904 it spent $1,085,055.

CHICAGO, ILL.—John H. Radford is preparing plans for an addition to an electric light plant at Fifty-eighth street and Cottage Grove avenue, Washington park, for the south park commissioners, who will take figures when the plans are ready. It will be one story, of brick and stone, with slate roof. The commissioners expect within two or three years to build a central electric light plant with sufficient capacity to light the entire park system. It will cost about $200,000. D. H. Burnham & Company are the architects.

TACOMA, WASH.—The Nisqually river water rights, right of way, etc., owned by John L. McMurray, of Tacoma, have been transferred to the Thompson Company, the consideration being named as $75,000. The company, it is stated, proposes to establish power-houses, electric generating plants and flume line. It secures 1,500 cubic feet of water per second from the stream. Easement for electric transmission lines is also granted. The stream, it is said, can develop fully 5,000 horse-power at the point where the company's power-houses are to be located and those interested believe that at least 5,000 additional horse-power can be generated.

BETHLEHEM, PA.—The Bethlehem borough council has entered into a new contract with the Bethlehem Electric Light Company. The borough agrees to pay the light company the sum of twenty-three cents per lamp per night, instead of twenty-seven and one-half cents as per old contract, and the sum of $18 per annum for each incandescent lamp. The borough agrees to use a minimum of 137 arc lamps. The light company is to accept payment for all arrears of light at the rate of twenty-five and one-quarter cents per lamp per night. The new contract, which calls for $800 worth of free lighting, is to become operative on and after November 1, 1905.

ST. PAUL, MINN.—A mortgage executed by the St. Croix Falls (Minn.) Improvement Company to the City Trust Company, of Boston, for $2,000,000, has been filed with the register of deeds. Bonds in the sum of $1,000 each, bearing five per cent and due in thirty years, will be issued. It is recited that the loan is made for the purpose of getting a right of way for the construction and equipping of an electric transmission line from the power-house of the company to Minneapolis, and for the purpose of constructing a distributing system in Minneapolis and elsewhere. A massive dam is being constructed at St. Croix falls which will furnish power to Minneapolis, and in time to a number of other cities of the state.

UTICA, N. Y.—Preliminary work has been started by the Hudson River Electric Power Company on the construction of a transmission line that will extend from the power plant on the upper Hudson to Utica. The survey is being made, and right of way being secured. When completed the line will be one of the longest in the East, extending a distance of nearly 100 miles. It is expected that the work will be completed by the middle of next summer. There will be two heavy wires strung on steel towers fifty-five feet in height. The towers will be of the same general type as those running from Niagara falls, and they will be about 450 feet apart. The line will stretch across country to Amsterdam and will come in an air line from that city to Utica, touching at some of the larger towns of the valley. The amount of power to be brought to Utica is estimated at 15,000 horse-power.

ELECTRIC RAILWAYS.

NIAGARA FALLS, N. Y.—The International Railway Company has bought out the Electric City Railroad Company.

EAST ST. LOUIS, MO.—At a meeting of the East St. Louis city council a franchise was granted to the St. Louis & Northeastern Railroad Company.

HARTFORD, CT.—The Connecticut Railway and Lighting Company has perfected arrangements for extending its system in the northern part of Bridgeport.

MONSON, MASS.—The selectmen of Monson have granted to the Springfield & Eastern Street Railway a location through the town for its proposed road to Fiskdale.

EPHRATA, PA.—There is a movement on foot to build a trolley line from the New Holland line, at Groffsdale, to White Horse. It is estimated that it will cost $150,000.

SMYRNA, DEL.—U. G. Glick, of Chicago, who is promoting the trolley line from Smyrna to Woodland Beach, states that an issue of $100,000 in bonds has been placed by a Chicago trust company which will act as trustee.

ALLIANCE, OHIO—The Alliance, Akron & Cleveland Electric Railway Company has been organized by the election of the following officers: president, Hugh Bleakley; vice-president, G. L. King; secretary and treasurer, Ray S. Kaylor.

MADISONVILLE, KY.—Work will soon begin on the Madisonville traction line, which is to be built from Madisonville to Nortonville, a distance of about eleven miles, making connection with the Illinois Central at that point.

COLUMBUS, OHIO—It is announced that the Scioto Valley Traction line will build a branch from Carroll to Millersport, on Buckeye lake, where it will establish a summer resort. The new line will be nine and one-half miles in length and will be completed in the spring.

ROCKFORD, ILL.—John Farson, the Chicago banker, has announced the sale of the Rockford, Beloit & Janesville electric line to Cleveland capitalists. Mr. Farson states that the line will be built from Janesville to Madison at once. The price paid is said to have been $1,250,000.

BLOOMINGTON, IND.—The Bloomington city council has granted franchises to both the Wabash & Southeastern and Indianapolis & Ohio Valley Traction companies. Both agree to have the work completed by May 1, 1908, or surrender their franchises. The Ohio valley surveyors are now at work.

FREDERICK, MD.—The promoters of the Baltimore & Frederick electric road, who recently purchased the Frederick & Middletown electric road, have assumed control of the latter system and organized by the election of the following new officials: president, James E. Ingram, Jr.; vice-president, J. Roger McSherry.

PITTSBURG, PA.—The Ambler Traction Company, chartered to build a line of trolley road about five miles in length, extending from Centre Square to Ambler, in Montgomery County, will operate in connection with the Montgomery Traction Company, the new name for what was formerly the Lansdale & Norristown Company.

BAY CITY, MICH.—The Bay City-Detroit Traction Company has let a contract to William C. Ross, of the Ross Construction Company, of Chicago, to build an electric railway over the route selected for the road, and the undertaking, according to written agreement, must be completed not later than one year from the first of October.

NEW YORK, N. Y.—The Brooklyn Rapid Transit Company will shortly place orders for $850,000 worth of new surface cars of the convertible four-motor type. Some of these are to be delivered to the company in January. The order for the trucks to go with this equipment has been placed with the Baldwin Locomotive Works.

SAN FRANCISCO, CAL.—An electric line to the Yosemite valley from Stockton is to be started at once. All the franchises are said to have been secured. The line will run to Jamestown, Chinese, Jacksonville, Big Oak Flat and to Gentry and will be 126 miles long. It is to be known as the Stockton & Yosemite Railroad Company.

HANCOCK, MD.—F. B. Banister and S. H. Bowman have been granted a franchise by the county court of Morgan County, W. Va., to build an electric railway from Berkeley Springs to Hancock. Work of construction must begin within six months from October 1, and the road must be completed within two years. The franchise is for fifty years.

ROCKVILLE, CT.—The track for the Broad Brook trolley is now finished for more than half the distance between Warehouse Point and Broad Brook. The company has decided to cross the Highland division of the New York, New Haven & Hartford Railroad at Melrose by a trestle, instead of following the original plan of going under the railroad tracks.

NEW HAVEN, CT.—Arrangements have been made by the Consolidated Railway for the construction of fifty-seven cars of the latest type and fourteen snow plows for the different divisions of the electric system. The cost will be about $400,000. The bodies will be built by the Wason Company, of Springfield, Mass., and will be assembled at the New Haven shops.

OWINGSVILLE, KY.—It is learned that Lexington capitalists, who own the Olympian springs, have decided to build a powerhouse at Olympia station and construct a nineteen-mile electric line from the springs to Owingsville. It is believed the Philadelphia syndicate which purchased the Central Kentucky traction line will extend its road to connect with the spring line.

CHICAGO, ILL.—William S. Reed, representing a syndicate of capitalists, has agreed to purchase the active property of the Chicago Electric Traction Company. The consideration is $200,000 in stock of the reorganized company and $650,000 cash. The road will be extended to Kankakee, Ill. When it is completed the syndicate may buy back the $200,000 stock for $100,000 cash.

MEMPHIS, TENN.—The Nashville Interurban Railway Company has filed an amendment to its charter, fixing the termini of the road at Gallatin, Sumner County; Mount Pleasant, Maury County, and Lewisburg, Marshall County. Preparations are being made to begin early construction. The road is to be the nucleus of an extended system of electric lines in Tennessee and Alabama.

BLUFFTON, IND.—Stockholders of an interurban to be constructed between Bluffton and Marion, Ind., known as the Marion, Bluffton & Eastern, have elected the following officers: president, Samuel Bender; vice-president, J. Wood Wilson, of Marion; secretary, R. F. Cummins; treasurer, W. A. Kunkel. Directors: S. L. C. Davenport, H. C. Arnold, L. C. Justus, L. A. Williamson, T. E. McReynolds and G. Max Hoffman, of Fort Wayne.

MUNCIE, IND.—The Delaware County commissioners at the opening of the October term of the commissioners' court granted a franchise to the Indianapolis, New Castle & Toledo Traction Company, for the construction of its line through and across the highways of the county between Muncie and points almost due south of the city on the county line. Work is to be started on the line not later than June 1, 1906, and cars are to be running within a year from that time.

LAGRANGE, IND.—The St. Joseph Valley Railroad Company has begun at Orland the work of grading for an extension of the line from Lagrange to Angola. It is the intention to work also from Angola, Mongo and Lagrange at the same time, and complete the grade this fall, if possible. Work on an extension of the line west from Middlebury (now the western terminal) to Elkhart will be taken up in the spring. The road, when completed from Elkhart to Angola, will be sixty-five miles in length, and is expected to form a part of a through line from Toledo to Chicago.

WESTFIELD, MASS.—The Western Massachusetts Street Railway Company has opened its new line between Westfield and Huntington. This is a twelve-mile stretch of electric road through the Westfield river valley, and is another link that will eventually make it possible to traverse the entire state from Boston to Pittsfield by electric cars. The Western Massachusetts company has franchises in the towns of Huntington, Chester, Becket and Lee, and it is planned to continue the present line to connect with the Berkshire street railway at East Lee, a distance of about twenty-one miles.

INDUSTRIAL ITEMS.

THE JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J., is distributing an attractive blotter calendar for October.

THE DEAN ELECTRIC COMPANY, Elyria, Ohio, has added to its attractive series of folders No. 8, which describes the No. 2 type common battery switchboards.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., at its directors' meeting on October 13 declared a regular quarterly dividend of one and one-half per cent.

THE INDUSTRIAL ENGINEERING COMPANY OF AMERICA, 32 Broadway, New York city, will be pleased to send its new bulletin descriptive of the industrial engineering, in all its branches, which the company undertakes. C. M. Conradson is chief engineer, and F. L. Howard, manager.

FRANK B. GILBRETH, Boston, Mass., general contractor, has issued a new publication calling attention to a number of important contracts which were carried out by him in very short time. In addition to the illustrations there are included a number of testimonials from different architects and persons for whom Mr. Gilbreth undertook this construction.

THE CHICAGO PNEUMATIC TOOL COMPANY, Fisher Building, Chicago, Ill., in special circular No. 52 describes the air-cooled Duntley electric drills. These drills are rapidly achieving a remarkable reputation for efficiency and general characteristics. The apparatus is well worthy of study, and this booklet should be secured by any one interested in this development.

THE AMERICAN TRANSFORMER COMPANY, Newark, N. J., announces the removal of its factory to its new building, 143-153 Miller street, corner of New Jersey Railroad avenue. This change of location has been made necessary by the steady growth of the business, and the company states that with the increased space and convenience acquired, even better results can be obtained than heretofore.

THE COLONIAL FAN AND MOTOR COMPANY, Warren, Ohio, reports the recent installation of twenty-five motors for the H. J. Heinz Company, Pittsburg, Pa., for the individual driving of can machinery and printing-presses. The company has also installed nineteen motors for the Kinnear Pressed Radiator Company, West Pittsburg, Pa. Fourteen large motors have been shipped to the Independent Packing Company and the Chateau Avenue Ice and Cold Storage Company, St. Louis, Mo.

THE L. B. ALLEN COMPANY, INCORPORATED, Chicago, Ill., has found it necessary to further increase its capacity for the manufacture and handling of Allen products. The company is now in a position to handle its business with greater facility and despatch than at any time in its career. The demand for all of the Allen products continues, and the satisfactory comments heard from users in all sections of the country assure the manufacturer that this condition of affairs will steadily improve.

THE NORTHERN ELECTRICAL MANUFACTURING COMPANY, Madison, Wis., is making a specialty of sending purchasers quotations on Northern electrical apparatus for application to machines and machine tool driving. The Northern company simply desires to learn the class of work to be accomplished and the voltage of the power circuit from which the current is to be taken. The company has had an extensive experience in all kinds of manufacturing plants, applying the motor drive for increasing the output.

THE STANDARD ELECTRICAL MANUFACTURING COMPANY, Niles, Ohio, is calling attention to the three forms of incandescent lamp which it is handling. The "Star" sign lamp is receiving considerable attention throughout the field. The "Star" mill type lamp, specially adapted for mills and factories, is also a popular article, as well as the "Star" central station lamps. In addition to these lamps, the company makes the "Prismo Star" lamp, which has a frosted globe and a prismatic reflector, producing a high quality of light diffusion.

THE GOLD CAR HEATING AND LIGHTING COMPANY, 17 Battery Place, New York city, is distributing its new catalogue describing and illustrating its improved heating apparatus for steam and electric railways. This catalogue embraces 124 pages, and is well printed and substantially bound in a cloth cover. In addition to the descriptive material there are considerable data of importance to steam and street railway master mechanics. The company's apparatus has been very successful, as is evidenced by a number of high-grade testimonials which are included in the present volume.

THE EASTERN CARBON WORKS, JERSEY CITY, N. J., is preparing to show a complete line of its standard and general forms of carbon work at the Madison Square Garden Electrical Show, to be held in New York city from December 11 to 23, next. A special feature of the exhibit will be the "Eastern" dry batteries. These batteries are made in various forms for telephones, electric bells, annunciators, gas lighting, automobiles, launches, gas engines, and all similar work. The various carbon products of the company include cylinders, porous cups, batteries, plates, discs, boxes, rods, smelting electrodes, brushes, and other specialties. The "Eastern" flashlight will also be displayed.

THE YOST ELECTRIC MANUFACTURING COMPANY, Toledo, Ohio, announces the control and manufacture of three leading specialties, as follows: the "Electrogrip," an appliance for use with an incandescent lamp and a drop cord. "Fiberlite" shades made of tough fibrous material, mottled green, etc., and lined with a heavy white coating of mineral fireproof material. A holder is combined with the shade, and it can be quickly and firmly attached to any socket. The double "Falcon" wrench, designed for fixture work. The offset allows a direct purchase on the work close to the wall or ceiling, without the danger of soiling the decoration. These wrenches are forged from the best steel, hardened and finished either blued or nickel-plated.

THE COUCH & SEELEY COMPANY, 26-28 Binford street, Boston, Mass., has taken over the telephone business of the Edmonstone Company, making a line of special apparatus particularly adapted to private lines, hotel systems, and small interior systems. This apparatus has been described in recent issues of the ELECTRICAL REVIEW. The Edmonstone product is unique in design and arrangement, and very well made as regards workmanship. The apparatus is added to the Couch & Seeley company's own line, enabling it to furnish a high grade of equipment for this purpose at a comparatively low price. This apparatus is all made with the idea in mind of reducing everything to the smallest possible space. The instruments have an artistic appearance, by reason of their small size and neat arrangement, and they are especially attractive in places where the artistic and compact is appreciated.

THE WESTINGHOUSE MACHINE COMPANY, East Pittsburg, Pa., has received three orders of large size for Roney mechanical stokers. One order, from the Jones & Laughlin Steel Company, Pittsburg, Pa., calls for sixteen 114-inch by 24 grate stokers; one from the Lehigh Valley Traction Company, Philadelphia, Pa., calls for eight 130-inch by 20 grate stokers; and another from the Pressed Steel Car Company, Pittsburg, Pa., calls for six 100-inch by 20 grate mechanical stokers. These stokers are of the inclined rocking-grate type with removable fuel plates, and are provided with the necessary actuating mechanism for automatically controlling the motion of the grate bars and the supply of fuel. They will be capable of burning low-grade bituminous coal efficiently and without smoke. In addition to these orders, a number of smaller ones have been received for plants throughout the country.

THE WHITNEY ELECTRICAL INSTRUMENT COMPANY, Penacook, N. H., has issued a sweeping guarantee which it will affix, in the form of a label, to every Whitney instrument sent out after September 30. The guarantee is as follows: "We guarantee that the materials entering into the construction of this instrument are of the best of their respective grades, flawless, so far as careful inspection could determine, and that the workmanship is also of the best. We further guarantee that this instrument has been tested and been found to be in proper adjustment and calibration on this date. Any recalibration or readjustment or repair that may be required within a period of one year will be effected by us gratis, provided that the instrument is returned with seals intact to this point, charges prepaid, for that purpose. If the seals are broken, a charge will be made, and no charges for repairs made by other parties without our written consent, will be recognized."